

**The Making of a Crisis in Mexico:
An Inductive Analysis of Media Sentiment and Information Cascades on the Value of the
Mexican Peso during the 2008 Global Financial Crisis**

By

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Abstract

In the two decades prior to the 2008 financial crisis, the Mexican government pursued policies aimed at liberalizing markets, while simultaneously trying to ensure the stability of the peso. These policies consisted of monetary and fiscal controls to keep inflation low and free trade agreements to reduce Mexico's dependence on the United States. The policies significantly reduced the country's public deficit and were implemented in hopes that they would help reduce the country's exposure to currency crises.

Yet, despite all provisions the Mexican government put in place, the country's peso still lost two percent of its value in the first three days following the bankruptcy of Lehman Brothers, the US-based investment firm. The loss was significant given the average appreciation of the peso in the months leading up to the crisis was one percent *per month*, and given that not enough time had passed to fully understand the impact that bankruptcy would have had on Mexico. By the following Monday, the peso recovered all of its lost value, suggesting that investors were uncertain about the true impact the events unfolding in the United States would have on Mexico's economy. It also suggested that the uncertainty and negative sentiment within the market during the initial week of the global crisis played a stronger role in the rapid depreciation and recovery of the peso than changes in market fundamentals.

Using an inductive analysis of the historical events, this thesis suggests the circumstances in which sentiment engendered by mainstream media and distributed through digital channels during the financial crisis could have contributed to the dramatic short-term swings in the price of the peso. Specifically, this paper focuses on the new, digital information technologies, their use among investors as a means for financial research, and the role of high-frequency trading (HFT) algorithms in initiating information cascades. HFT algorithms account for nearly 70

percent of daily trading volume in financial markets and can magnify negative market sentiment among rational investors. Utilizing historical trading data for the peso and headlines and tweets published by the Thomson Reuters news group during the crisis, I seek to illustrate the correlations between market sentiment manifest in digital media and the price movements of the peso, indicating possible herd behavior tendencies in the form of information cascades.

Though it is not possible to empirically separate the market movements of informed decision-makers from the information cascades of investors and HFT algorithms reacting to media, the fact that information cascades can and do exist as demonstrated by specific examples in this paper has significant implications for the Mexican peso. The existence of information cascades implies that having strong macroeconomic fundamentals is no longer an adequate safeguard against the immediate impacts of external crises. As social media becomes the main source of breaking news and market sentiment for mainstream media and investors, it becomes vital for emerging countries such as Mexico to monitor social platforms for sentiment related to the domestic economy in order to proactively address investor pessimism. Finally, emerging country governments can utilize these platforms to push out relevant and truthful information about the economy in order to diminish investor uncertainty and minimize the impact of externally-induced information cascades.

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Chapter 1: Introduction

The twenty-first century has been defined by the introduction of advanced internet and digital technologies that have fundamentally changed the way the world connects and gathers information. While this new technology has created significant societal benefits through information aggregation and social connectivity, it has also intimately connected financial markets around the world in ways that had not been possible prior to the invention of the internet.

The global financial crisis that began in 2008 exposed these connections and fully demonstrated how the perceptions of weakness found in one economy could be transferred to economies across the globe. The speed at which new information technology allowed investors to both observe and react to new information and market sentiment globally magnified the opportunities for investors to mimic one another. When uncertainty was prevalent during the first week of the crisis and new information was limited to speculation, this mimicking behavior became more severe as investors looked to the markets to determine which actions they should take. As major investment banks in the United States started to fail in 2008, the resulting uncertainty triggered a worldwide panic. In an attempt to limit losses, investors looked to the markets and mainstream media to determine which assets they should buy or sell. This created a situation where some assets lost significant value within hours of being perceived as too risky, including assets such as the Mexican peso.

Mexico was the Latin American economy most affected by the crisis. The country's ties to the United States and past issues with currency crises made it an easy target of investor pessimism, despite the country's prior and contemporaneous attempts to reduce its macroeconomic exposure to financial crises outside of its domestic economy. As the crisis

unfolded, Mexico's economic outlook appeared to worsen; the peso devalued at an average rate of one percentage point per day from September to October 2008, while the previous average variability in the year prior to the crisis was a gain of one percent *per month* (Banco de México, "Foreign Exchange Market (Exchange Rates)"). The swift change in sentiment about the peso indicated that perceptions of risk were playing a larger role in the currency's valuation than visible changes in macroeconomic fundamentals.

Using an inductive analysis of the historical events of the global recession, this thesis suggests the circumstances in which sentiment published by mainstream media and distributed through digital channels during the crisis could have contributed to the short-term dramatic swings in the price of the peso. Specifically, this paper focuses on the role of new digital information technologies, such as the use of search engines and social media as a means of research among investors, and the use of high-frequency trading (HFT) algorithms – which account for nearly 70 percent of daily trading volume in financial markets – can initiate an information cascade, increasing pessimism among rational investors. Utilizing historical trading data for the peso and headlines and tweets published by the Thomson Reuters news group during the crisis, I seek to illustrate the correlations between market sentiment and the price movements of the peso, indicating possible herd behavior tendencies in the form of information cascades.

Information Cascades

Information cascades are periods of time in which the reaction of few individuals or groups to a change in news or sentiment causes other investors to disregard their own information in favor of taking the same actions of the first movers, believing that those first few individuals or groups have better information than them. This "herd" behavior of mimicking the first movers can be rational in periods of high uncertainty, when both limited information and

time constraints incentivize individuals to follow the behaviors of perceived “experts” rather than risk the chances of possible losses that might occur when taking the time to gather all the necessary information themselves.

However, as more individuals choose to disregard their own information in favor of following the group, asset prices can gain momentum and move too far away from fundamental values. As several individuals realize that prices are out of alignment and begin to take actions contrary to the actions of the group, then the cascade “breaks,” allowing asset prices to eventually return to levels that are closer to their true values. These sudden losses and gains that occur during and after an information cascade increase the short-term volatility of asset prices in the markets. Thus in the short-term, volatility inhibits market prices from being a reliable source of information about the true value of an asset.

Noting the presence of information cascades during the 2008 financial crisis is important because it provides one possible explanation for the astounding effect that a crisis in the United States had on Mexico beyond just the effects of trade. Given that Mexico was experiencing one of its most stable political and economic periods in decades and had no immediately visible ties to the finance instruments that were negatively affecting large investment firms in the United States, it appears that the effect the first week of the financial crisis had on Mexico was the direct result of fear – a real and rational fear that the chaos in the United States would somehow send Mexico into a currency crisis.

Inspiration Behind the Research

This research is an extension of my interest in the 2008 global financial crisis which began in 2008, when I was a sophomore in college. At the time, I was taking an economics

course titled “Money, Credit and Banking,” and my professor proclaimed that the crisis was an excellent case study of the intricacies of financial markets.

Unfortunately, it was a lousy time to be a college student. During that semester one of my parents became a victim of the layoffs that were all too common during that period. With that job went all sense of financial security and a significant portion of my college tuition. Determined to uncover the source of all the distress, I devoted my senior honors thesis research to figuring out who or what was the cause of the crisis. I quickly realized that the situation was a lot more complex than I had previously expected.

Five years later, my interest in the crisis expanded past the United States and into Mexico. I was curious why Mexico suffered significantly more than the United States, even though Mexico was not the source of the original economic crisis. Research conducted within the context of my Latin American studies curriculum caused me to explore some of the many possible causes of the crisis experienced in Mexico, from the on-going drug war, persistent poverty and the government’s emergency policy strategy.

In my research I discovered a trend: a crisis usually originating in the United States would create economic turmoil in Mexico, forcing its government to scramble in order to stem the flight of capital out of the country. Each time, resources would be wiped out, and the middle and working classes would bear the brunt of sweeping unemployment, high inflation and abject poverty. It seemed that just as Mexico’s economy would start to gain momentum, a crisis would cause it to hit the proverbial “reset button,” forcing the country to start from scratch both politically and economically.

I also noticed that with each crisis, the Mexican government put together provisions to hedge against future devastation. Budgets were balanced, trade was liberalized, debts were

reduced and emergency funds were gathered in preparation for the next major crisis. With each recession, Mexico addressed its vulnerabilities to external shocks with policy reform and new economic strategies. The 2008 financial crisis was the first time that Mexico had weathered such a severe global recession without experiencing a devastating currency crisis. Mexico implemented all of the latest macroeconomic strategies, including stimulating the economy, opening up currency swap credit lines with the United States and maintaining a balanced budget to demonstrate its fiscal restraint.

Yet capital flight from the country was still severe. According to Sidaoui, Ramos-Francia and Cuadra (2011), “during the last quarter of that year [2008], total foreign investment was only around 10% of the level reached a year earlier,” with a capital outflow of nearly \$10 billion USD from portfolio investments alone (pgs. 248-249). It appeared that foreign investors expected the worst in Mexico, despite the presence of decisive, calculated government interventions to shelter the domestic economy from harm. While the actions of the Mexican government ultimately helped the economy to recover after a swift and brutal recession, those actions seemed to do very little to affect investor sentiment about the country in the short-run until Mexico’s growth rate surpassed that of Brazil in 2010.

I began to wonder if the source of the problem had more to do with investor sentiment rather than Mexico’s economic fundamentals. It seemed that many of the country’s financial problems were the result of actions taken by foreign investors that had a significant financial impact on the economy as a whole. I did not believe that investors were intentionally and maliciously trying to weaken Mexico’s economy; I did, however, believe there were certain aspects of investing behavior – such as the way information was gathered and used to make

decisions – that ultimately inhibited Mexico’s efforts to become an established economy. This thesis is the culmination of my findings.

The Role of Uncertainty and Fear in Herd Behavior

The rapid flight of capital away from both Mexico’s peso and stock without obvious cause indicates that perception was creating the panic, rather than the real economic conditions within Mexico. As had happened in past crises that affected Mexico, outside investors appeared to be participating in herd behavior, taking their investment funds out of the Mexican economy because other investors were doing the same thing. The main difference between the 2008 crisis and crises Mexico experienced previously was that the run on the currency was not triggered by the actions of the Mexican government. Instead, uncertainty was introduced to the global market as a whole when advanced economies started to experience a financial meltdown.

Uncertainty plays an important role in herd behavior. It represents a change in closely held beliefs, forcing people to reevaluate their assumptions and the information they use when making decisions. From an investing standpoint, periods of uncertainty required new strategies to take into account new information about which investment will incur the greatest risk or bring about the greatest reward. The uncertainty also creates a sense of urgency; investors need to know what has changed and how that change affects their investments, before major financial losses are incurred. This urgency creates incongruities as investors seek out information, but fail to take time to ascertain the quality of the information before acting upon it.

Yet uncertainty can also create opportunities for information exploitation. One of the main reasons investors may choose to act on new information before conducting a thorough analysis of an investment decision is the desire to make first-mover profits. Since their founding, financial markets at their core have been not only a compilation of funds but also a competition

among investors to make excess profits by being the first to exploit new information in the market.

This competition is so prevalent in financial markets that entire companies have been created to find and distribute information quickly to investors willing to pay for it. The news agency Thomson Reuters was created from this competition when in 1851 founder and financial publisher Paul Julius Reuter used carrier pigeons to provide subscribers with breaking financial news days in advance of any other source (*Reuters*, n.d.). Now, instead of pigeons and newspapers, companies and investors are utilizing digital newswires and Twitter, incorporating this information into algorithms that automatically “read” and act on the news.

The Role of Media and Technology in Information Cascades

Yet while this race to “beat the market” is not new, the technology developed over the last decade to help companies exploit new information can have market-destabilizing effects. If investment companies seek out the same information for their automatic trading algorithms – via sources like *Reuters*’ digital newswire or Twitter feeds – then there is a chance that the trades completed by these algorithms can initiate information cascades. These cascades represent a type of herd behavior where snippets of information cause large, coordinated actions of asset buying or selling by groups of unrelated people and organizations, distorting the price of an asset significantly from its actual value. The speed at which technology and algorithms allow trades to be completed means that new information introduced to the market moves asset prices before it is humanly possible to pick up on subtle inaccuracies in the data. Thus even rumors could cause a tremendous swing in asset prices if accidentally published by a “validated” news source before the organization has a chance to redact the inaccuracies.

Inaccuracies in news data can be very common when reporting on breaking news, especially since news agencies are under just as much pressure to be the first to “get the exclusive” on an important story as investors are to be the first to use the information. Jack Shafer (2008), a journalist at *Slate*, a digital magazine owned by *The Washington Post* newspaper company, demonstrated the tendency of even “authoritative” news agencies such as *The New York Times* and *The Wall Street Journal* to print rumors as fact in an exposé about the inaccuracies published during the 2008 Mumbai massacre. “Breaking news,” he explains, “especially complex breaking news – has always defied the best reporter’s attempt to get the story both first and right.” Therefore, in situations of great uncertainty such as a crisis, when the need for timely and accurate information is most critical, it stands to reason that the news financial companies, investors and their algorithms rely on can often be *wrong*.

In addition, research shows that when negative news is published, investors tend to overreact. According to economists Roberto Casarin and Flaminio Squazzoni (2013), “investors are more sensitive to negative news, especially when the market is dominated by uncertainty and unpredictability,” creating downward pressure on asset prices (p. 1). In addition, even the words journalists use to explain situations of uncertainty can affect the way a market behaves through a phenomenon known as the “framing effect.” Professor of media, public and international affairs Robert M. Entman explains the importance of framing, or the lens through which a problem is described:

...the frame determines whether most people notice and how they understand and remember a problem, as well as how they evaluate and choose to act upon it [...]

Receivers' responses are clearly affected if they perceive and process information about one interpretation and possess little or incommensurable data about alternatives. This is

why exclusion of interpretations by frames is as significant to outcomes as inclusion (pp. 53 & 54).

In other words, if mainstream media print news about uncertainty in the markets through a very negative frame, and investors are limited in both their time and access to other data sources, then investors will react negatively and create even more volatility in the markets. This creates a situation where the sentiment of news articles solidifies the sentiment of the markets, making it difficult to objectively observe the events as they occur. For example, if investors feel pessimistic about the market, and then read articles from mainstream media reflecting that pessimism, then their concerns are in a way confirmed, even if no new hard information is presented about the actual state of the economy. This confirmation bias may prevent them from seeking out other sources of information that may contradict the pessimism.

Negative framing may cause additional problems if it affects the actions of HFT algorithms. As will be discussed in detail below, HFT algorithms make up a significant portion of the total volume of trades completed in financial markets, meaning that their trades can visibly affect the overall market price of an asset. Since HFT algorithms make trades instantaneously based on a keyword and sentiment analysis of information published by mainstream media sources, a negatively framed article may be reflected in the stock price of an asset almost instantaneously, and before investors have a chance to read the information themselves.

Thus by the time investors read the information published by mainstream media, the markets could have already reacted, confirming the suspicions of investors who were already pessimistic about the market. As these investors also choose to sell their stocks, asset prices continue to fall at a rapid rate. This can create conditions of uncertainty in which skeptical investors may wonder if they too should join in the sale of the asset, even if they may suspect

that the price of that asset is dropping below its actual value. When the uncertainty caused by rapid changes in the market environment cause investors to doubt their closely held beliefs, they may then start to looking for sources of information they consider to be “authoritative” to see how they should react.

Executive Business Editor of the *Huffington Post* Peter Goodman (2011) explained his experience working at the *New York Times* during the 2008 crisis and the kind of impact “authoritative” articles could have on the markets:

Inside our newsroom in midtown Manhattan, we understood that we were not merely passive chroniclers of external events. The sportswriter can describe what is happening on the field from a dispassionate distance, without imagining that the words he types may somehow influence the events he is witnessing. Not so for those of us writing about the financial crisis: we were effectively on the field while the game was still under way. Investors and markets and ordinary people would move their money in reaction to what we and other major media were reporting, and this would in turn affect the policy climate, the perception of the need for emergency measures, the politics of the debate over those measures, and the public mood, which then reverberated back on everything else (p. 110).

Money was made and lost by the trading algorithms and individuals that used mainstream media to determine what trades to make. When mainstream media chronicled the initial impact of the crisis on Mexico’s peso, the very words used to describe it increased the perceived riskiness of investing in the country by reflecting the pessimism of the market. Headlines such as “Mexico Peso Falls Over 1 pct on US Financial Woes” (Randewich, 2008) and “Emerging Market-Assets Smacked Down by Wall Street Ructions” (Versiani, 2008) led investors to

believe that emerging economies like Mexico were more vulnerable to financial conditions in the United States than the conditions warranted. Overall, the prevailing negative sentiment about Mexico was enough to make investors forget that Mexico was in a stronger economic position than it had been in former currency crises, despite the fact that country had provisions in place to reduce its exposure to currency risk.

In the span of a month, Mexico's peso lost nearly 25 percent of its value and continued to decline well into the first quarter of 2009 (Banco de México, "Foreign Exchange Market (Exchange Rates)"). With the decline, mainstream media became progressively more negative, leading to a December 2008 *Forbes* cover story titled "Mexico: The Next Disaster," focusing on the country's struggles with unemployment, poverty, corruption and increasing drug-related violence (Bogan et al., 2008). To an outsider looking in, Mexico appeared to be in a state of self-destruction. The reinforcing cycle of fear and flight meant that the value of the peso continued to fall well into March 2009, even as the Mexican government implemented emergency currency swap lines and austerity measures to combat investor pessimism.

Methodology

Mexico provides just one example of the influence that media sentiment, information technology and investor behavior can have over an emerging country's currency and domestic economy. Given that this influence is largely beyond the policy influence of the emerging economy's government, new strategies become necessary to combat the domestic consequences of misinformation and external pessimism. Before strategies can be developed however, there has to be an understanding of how situations of herd behavior can arise, and the effects information cascades can have on an economy if the cascade is not "broken" with the introduction of positive information.

This thesis analyzes historical foreign exchange trading data for the Mexican peso and *Reuters* headlines and tweets to demonstrate correlations between market sentiment and the value of the peso. These correlations reveal probable instances of information cascades, based on the price movement of the asset and the ambiguous information available in the market during periods of heightened uncertainty. By identifying the conditions for information cascades, this thesis is then able to show how significant cascades might create real financial problems within an economy – problems which could then trigger major financial recessions like the one experienced in Mexico in the early part of 2009.

The data were derived from two sources: the Chicago Mercantile Exchange (CME) Group and Thompson Reuters. These two companies were chosen for both their extensive data archives and for their fundamental ties to the markets for foreign exchange. The following provides a brief overview of each company and the data that was chosen for this analysis.

CME Group

CME Group (formerly known as the two separate companies CBOT and CME) was the world's first exchange for futures contracts – agreements between two parties to purchase a pre-determined quantity and quality of a good for a certain price on a specified date in the future. Unlike stocks, futures contracts only existed if two parties agreed to trade; the only limit to the number of contracts was the number of people willing to trade. These contracts became very popular in the 1800s in the trade of commodities like grain, so CBOT created a market for their trade in 1848, and standardized the contracts in 1865 (CME Group, “Timeline of CME Achievements”). This effectively created a “market price” for commodities like grain, providing suppliers (farmers) a guaranteed price contract for their future crops, while also providing buyers (i.e. bakers) a way to lock in a price for the goods they were going to need in the future.

Throughout the 1900s, the exchange expanded to include the trade of futures contracts in other commodities like meat, soybeans and livestock, while after the 1970s, the exchange featured futures in precious metals, mortgages, currencies and stocks (ibid). By the end of the 1990s, CME launched the first electronic platform for the trade of futures contracts, making it possible to place trades without physically being at the exchange. Between 2005 and 2006, CME and CBOT merged into CME group, while simultaneously partnering with Reuters to create the first ever over-the-counter global market for foreign exchange futures (ibid and Thomson Reuters, “Company History”). Thus, by the 2008 global financial crisis, traders were making electronic trades in futures contracts for the Mexican peso, utilizing a platform designed by both CME Group and the Reuters financial information service.

CME Group has since kept an archive of all the futures contracts initiated and completed for the Mexican peso through its exchange. The company provides the raw data from these historical trades at a discounted fee for academic purposes, but does not provide or endorse any analysis of the data. The organization and analysis of the data for this thesis is strictly my own.

I utilized three months of historical futures data for the Mexican peso: September 2008 – when the global crisis began with the Lehman Brother bankruptcy; December 2008 – when the United States government bailed out the top three US auto manufacturers who had extensive operations in Mexico, and when the pessimism about Mexico reached its highest point; and March 2008 – the month the price of the peso reached its lowest point and began to appreciate once more. After an initial analysis, I narrowed my focus to the month of September, when market uncertainty was at its highest and there was still hope that an all-out global recession could be avoided.

Within the data for the month of September, I utilized the floor closing prices of each day. These prices represented the “settlement price” or the price at which futures contracts are adjusted to equal the market price of the asset for that day. According to Shmidt (1985), a futures contract is settled through a process called “marking to market” where the difference between the market value and the contract value is paid in cash by the loser to the winner (p. 50). For example, a contract is made when a buyer and a seller both agree to a set price for a specified quantity at a future date; no money or product is exchanged in the making of this agreement, so the present “settlement price” is zero. But if the day after the contract is created the market price for the asset decreases by \$1 per unit of the asset, the buyer “loses” because he or she has agreed to pay a higher price per unit, while the seller “wins” because he or she agreed to sell at a higher price than what the market currently will allow. The contract is “settled” at the end of the day when the buyer pays the seller the \$1 per unit, making the remaining price to be paid in the future equal to the current market price ($\text{market price} = \text{future agreed-to price} - \$1 = \text{settlement price}$). In the end, the closing or “settlement” price is equal to the current market rate for the asset. CME provides four “floor closing prices” for each day, representing futures contracts for three, six, nine and twelve month intervals. For simplicity, these four prices were averaged for this analysis.

The other two months of data were used to provide supplementary evidence of the considerable effects of a global recession on Mexico’s economy. When data were needed for the months not purchased from CME, I used averages of the price data collected by the Central Bank of Mexico and made available via the bank’s website. Overall, data from the Central Bank of Mexico was only utilized to determine the total losses of the peso from September 2008 to March 2009 in order to provide a comparative perspective.

Thomson Reuters

The data from CME Group, while insightful, cannot show the sentiment that was present in the markets while trades for the Mexican peso were being executed. In order to gain this qualitative information, I utilized Thomson Reuters as a second source of data. Though many other major news agencies existed and reported on the global financial crisis as it was happening, few had the unique ties to investment markets that Reuters possessed.

As mentioned previously, the company Thomson Reuters (hereto referred to as Reuters) was developed to be an information provider for financial markets that could get investors critical news before any other source. Paul Reuter used carrier pigeons to transport “breaking news” from Paris to subscribers in London, and made significant investments in telegraph technology. According to the company, Reuters was the first to bring news to Europe about the assassination of US President Abraham Lincoln in 1865, “throwing European financial markets into turmoil” (Thomson Reuters, “company history”).

Reuters has since extended its reach, increasing its ability to be the first to the market with breaking news by developing information technology to complement its journalists’ efforts. Over the company’s history, it has been a news company, a telegraph company, a publishing company, a broadcasting company, and – briefly – an oil company. By the 1960s, Reuters was leading the way in computerizing stock quotes, creating Videomaster to display stock and commodity prices on a video screen. By 1973, the company launched Reuter Monitor Money Rates Service, creating the first electronic marketplace for foreign exchange. Then, building on that service, Reuters launched its Monitor Dealing Service in 1981, which allowed traders to make trades of foreign currency over the Videomaster terminals (ibid). By the 1990s, Reuters offered a Financial Television Service for traders that provided live coverage of breaking news on trading screens, directly linking news broadcasts to trading floors. By the time Reuters

partnered with CME Group in 2006 in the markets for foreign exchange, the company had also developed products that would allow traders' computers to "read" the news Reuters was publishing. This made it possible for financial companies to develop automatic trading algorithms that could "read" and react to news instantaneously, before human traders could physically execute a decision to make a trade.

All of these technological advancements in the development of the foreign exchange markets and the distribution of information between investors gave Reuters a unique position as a member of mainstream media. While there were several media providers to choose from during the crisis, news from Reuters was distributed directly to investors via their trading terminals, screens within the exchanges, agency partners, broadcast media, internet articles, RSS feeds and news feeds to automatic trading algorithms. Reuters even used Twitter, a micro-blogging social platform that was only about two years old at the time, using three of its four accounts known to exist in 2008 to tweet about the crisis (personal communication with Thomson Reuters, March 11, 2014, and tweet archives via twitter.com). The only other official news outlet known to also be on Twitter at the time of the recession was the Wall Street Journal (Ibid).

In addition, Reuters was one of a few news agencies covering the crisis that viewed the events through a more international lens. While *The Wall Street Journal* and *The New York Times* covered the crisis extensively, their focus was almost exclusively on the effects of the crisis on US and European markets. When "emerging markets" were mentioned in articles, it was most often in reference to Japan, Russia and other parts of Asia. Mexico was mentioned rarely,

and usually only within the context of President Calderon's new war against the drug trade.¹ Thus, Reuters was chosen as the main source of news content due to the company's ties to financial markets, vast channels of distribution and international lens.

Two types of data were gathered from Reuters. First, I gathered the company's daily headlines from their online archives. These daily archives of the crisis contained the exact wording of the headlines published each day, the time they were published and the frequency each article was "re-surfaced" or republished on digital channels throughout the specified day. The headlines serve as both a storyline of crisis events as they were occurring and an archive of dynamics in the market sentiment during those events.

The second type of data gathered was archived tweets from three of the four Reuters Twitter "handles" (accounts) in existence that published news about crisis events. These tweets provided supplementary, qualitative data of the news coverage and sentiment of the crisis by demonstrating headlines that were considered important enough to warrant a tweet. At the time of the crisis, Reuters was publishing anywhere from three to fifteen tweets a day via its handles. In contrast, Reuters published upwards of 200-500 times a day on its website, depending on the number of updates needed to cover breaking events. Yet, despite lacking the volume of the minute-by-minute updates of the website, the tweets provide a means to limit the noise of the headline data by narrowing the focus to the topics that were considered most important to share with readers that day.

¹ This was determined after extensive review of the microfilm archives of these papers in the University of Kansas Watson Library archives for the two weeks prior and after the bankruptcy of the US investment firm Lehman Brothers.

Together, the quantitative foreign exchange data from CME and the qualitative news data from Reuters construct a narrative that highlights periods during the crisis where information cascades were most likely occurring. When interviewing investors as they make decisions during a crisis period is not a feasible option, this method of inductive analysis provides a means to retroactively examine market trends for patterns of herd behavior. This method is based on a similar method Tetlock (2007) used to analyze media sentiment in relation to volatility in stock market prices. By acknowledging that herd behavior exists and that it can have a significant effect on the economic welfare of emerging economies like Mexico, it becomes possible to focus policy discussions on limiting a country's exposure to this kind of risk through active reputation management.

Structure

The rest of the paper is structured as follows: chapter two lays the ground work for understanding the assumptions investors had about Mexico, and how the country would fare in the 2008 financial crisis, by providing the historical context of Mexico's previous encounters with global recessions. Chapter three then describes how changes in information technology have fundamentally changed the way information is gathered and used by traders to make investment decisions. Next, chapter four gives the theoretical background of the herd behavior concept, as well as the different environmental factors that make investors more prone to defer to the crowd when making decisions. Once the types of herd behavior have been defined, chapter five follows with an explanation of other research into the effects of market volatility, media sentiment and herd behavior in Mexico through a literature review. Transitioning into the data section, chapter six maps out the challenges and assumptions of this kind of analysis, along with

the hypotheses and results of the analysis. Finally, chapter seven concludes with a discussion of the future implications of this research's findings for Mexico and other emerging economies.

Chapter 2: Crises in Mexico – A History of Currency Runs

History provides critical perspective in understanding the underlying assumptions in the behaviors demonstrated by foreign investors during the 2008 financial crisis. Without this perspective, it would be difficult to imagine where the source of investor panic was ultimately rooted. Porzencanski (2009) stated that the “financial vulnerability of Latin America to the vagaries of international capitalism has been on all too frequent and public display” since the revolutions for independence in the early 1800s (p. 7). As it turns out, the rapid depreciation of Mexico’s peso during the first month of the global crisis was neither the first – nor the worst – time Mexico faced a run on its currency.

Mexico has been acutely vulnerable to changes in the financial environment of advanced economies throughout its history, particularly with respect to economic changes in the United States. Since the 1980s, Mexico has experienced at least three recessions (not including 2008), two of which resulted in currency crises. The following is a brief overview of the channels through which financial crises are traditionally transmitted, how those channels have affected Mexico since the 1980s and the steps that the Mexican government has taken to reduce the economy’s exposure to those channels.

Crisis Transmission Channels

Though Mexico had strong macroeconomic fundamentals in place at the onset of the 2008 financial crisis, the country was still subjected to a significant amount of investor pessimism, throwing the economy into a deep recession. According to Kingstone (2013), the pessimism surrounding Mexico and other Latin American countries during the 2008 crisis was “rooted in the long history of [these countries] relying on development models that heightened Latin America’s exposure to financial crises” (p. 64). In the case of Mexico, these development

models included a reliance on commodities in the late nineteenth century, the import substitution industrialization model of the 1970s and the fixed exchange rates of the 1990s. These models increased exposure to external financial crises via three main forms of transmission: credit, trade and herd/ contagion effects.

Credit crises are caused when there is a reduction of the supply of a currency, either through a “tightening” of monetary policy through a physical reduction of the money supply or a severe increase in the global demand for the currency, reducing the liquidity in the global economy. As a result, there are fewer units of the currency available for use in trade, increasing their overall value. While the reduction in the money supply successfully increases value of the affected currency, it also increases the cost of taking out loans in that currency due to higher interest rates, resulting in suppressed demand.

During the 1970s, when debt in emerging economies was denominated in US dollars at variable interest rates, an increase in interest rates immediately magnified the burden of debt payments on the economy. In addition, the reduced supply of major trading currencies made it more difficult to maintain the necessary foreign reserves needed to protect the values of fixed exchange rates. Ultimately, rising costs of debt service and over-valuations of fixed currencies crippled emerging economies, who had no other choice but to try and reschedule debt service payments, and let their currencies correct to market values.

Another means of transmitting financial crises from advanced economies to emerging economies is in the form of trade crises. Advanced economies like the United States and Europe make up a significant portion of global consumption demand for goods and services. Therefore, recessions in these countries can frequently “spill over” into emerging economies, especially if export trade is a large source of foreign exchange inflows into the emerging economy. In

addition, discoveries of new sources of commodities can also affect emerging economies that depend on commodity trade as a main source of income, since the new supply reduces the global market price for that commodity. Overall, the emerging markets with the least income diversification are most likely to be vulnerable to transmissions of financial crises through international trade markets.

Finally, external financial crises can be transmitted to emerging economies through herd behavior and contagion effects. Though explained in detail in the next chapter, herd behavior occurs when information or cultural pressures induce many individuals to make the same behavioral decisions. In the case of emerging economies, herd behavior usually happens when new information about those economies leads investors to believe that investing or doing business in those countries has become too risky. A contagion effect occurs when pessimism about one economy is then applied to another, causing investors to withdraw significant funds from the countries perceived to have similarly structured economies. The following examines the historical application of these channels of crisis transmission in Mexico since the 1980s, and how the government addressed the economy's vulnerabilities.

The Mexican Debt Crisis of 1982

During the 1970s, Mexico participated in the popular economic development strategy of that era, known as import substitution industrialization (ISI). The basic premise of ISI was to encourage domestic development by replacing the demand for imported goods with demand for domestic goods. To get people to make the switch, the government supported local industry by utilizing tariffs, subsidies and non-tariff barriers to imports in order to make domestic goods appear cheaper than their foreign counterparts. Tariff and tax revenues were then used to fund subsidies, generous employment benefits and wages, and public infrastructure projects. Finally,

the government manipulated the exchange rate for the peso to create better terms of trade for Mexican goods globally, while also ensuring that the machinery not made in Mexico but needed by local factories could be imported at more favorable prices.

In addition, a significant portion of the government's attention went into strengthening local industry. Yet, steps were also taken to create social programs to improve the economic standing of Mexico's poor. This included transfers of resources from the wealthy classes to the working classes through artificially high wages and significant welfare benefits. When tariff and tax revenues were not enough to cover the bill, the Mexican government utilized revenues from the nationalized oil company that had just discovered new fields of oil reserves. In 1973, oil revenues were amplified when the OPEC oil embargo against countries that supported Israel reduced the global supply of oil and rapidly magnified the price of the remaining supply.

Steadily increasing oil revenues created a false sense of economic security and stability. As a result, both the public and private sectors in Mexico began to take on more foreign-denominated, variable interest rate debt in order to pursue increasingly ambitious growth strategies. This leveraging strategy – or using borrowed money to increase the returns on investments – worked well for Mexico throughout the 1970s, and the economy grew rapidly. ISI was successful during this time, giving the domestic economy the protection it needed to create the infrastructure for a manufactured exports-based economy.

Yet the growth rate proved unsustainable in the long run. To counteract increasing inflation caused by exaggerated oil prices, industrialized nations tightened their monetary supply during the mid-70s, thereby increasing interest rates on borrowing. These countries also took steps to reduce their dependence on OPEC oil by increasing domestic production of oil products, reducing consumption through smaller cars, rationing existing supplies and using other fuel

sources. From 1979 to 1981, the combined oil consumption of the United States, Europe and Japan fell by 13 percent (Garvin Jr., 1981, p. 151). And as a result, the global price of oil slowly began to fall. This had a three-fold effect on Mexico's economy, exposing the country's vulnerability to fluctuations in credit prices, trade volumes and changing investor sentiment.

First the tightening of monetary policy in the United States increased the cost of borrowing dollars by increasing interest rates. This caused the variable interest rates on Mexico's debt obligations to also rise, significantly multiplying the cost of servicing the country's outstanding debt. Next, the rising global interest rates started to affect consumer spending, while increased unemployment rates and a lack of economic expansion hurt both consumer confidence and incomes. This triggered recessions in the United States and Europe, which then spilled over into Mexico via a lack of demand for its exports. Finally, the decline of global oil prices tempered the Mexican government's ability to maintain its current rates of spending, and its ability to shield the domestic economy from the global recession. In order to service the foreign debt, the government had no choice but to continue to borrow money to meet its obligations.

Once this cycle started, it was not long before the limitations of ISI became visible. While the strategy had boosted Mexico's ability to build critical infrastructure needed to create a market for manufactured Mexican goods, the program did very little to permanently change the severe inequalities between the country's richest and poorest populations. In addition, ISI put a significant strain on the financial stability of the government, making it dependent on foreign-denominated debt. Mexican businesses long shielded behind high tariffs on imports found it difficult to compete in the global market. The financial stress started to create problems within the country, and violence broke out over increasing prices and shortages of staples. By August

1982, the culmination of all these factors meant that Mexico was no longer able to service its debt obligations, causing the government to ask for rescheduling of its debt service obligations.

The request caught investors off-guard, and triggered a region-wide panic. Suddenly, investors were concerned that all emerging economies might be facing the same struggles that Mexico succumbed to, triggering a contagion effect as they withdrew their planned investments in these countries. Investor concern was legitimized when President Lopez Portillo (1974-82) nationalized the Mexican banking industry in an attempt to stem the run on the Mexican peso, signaling that foreign investor profits were at risk of being seized by the Mexican government. What started as a credit crunch and mild financial crisis quickly escalated to an all-out currency crisis as investors dumped their pesos in favor of the more stable US dollar.

When President Miguel de la Madrid Hurtado (1982-88) took office, he attempted to get the economy under control by implementing severe austerity measures to reduce the debt. According to Foster (2009), foreign banks, the International Monetary Fund (IMF) and the World Bank –who all owned portions of Mexico’s debt – demanded specific actions from de la Madrid before any more money would be given to the floundering economy. This included the IMF conditionality of devaluing the peso and cutting public spending by one-third, “[lifting] price controls on thousands of commodities (tortillas increased 40 percent in price, bread 100 percent), and depleting the resources of his predecessor’s rural development program by targeting federal funds on increasing export production rather than domestic food stuffs” (p. 214). Yet, even as the economy slowly staggered towards a recovery, two earthquakes beset the country in 1985. In what became known as the worst natural disasters in the country’s modern history, the earthquakes devastated central Mexico, resulting in an estimated 7,000 – 20,000 deaths and 100,000 people stranded without homes (Foster, 2009, p. 215). The grief and anger

over the high death toll, paired with the government's unpopular austerity measures and delayed rescue response, undermined the public's confidence in the political system. Political upheaval ultimately made economic reform very difficult to implement, and the 1980s became known as Mexico's lost decade of growth.

The 1994 Mexican Peso Crisis and the Tequila Effect

As the lost decade drew to a close, President Carlos Salinas was elected to office. Continuing the highly controversial policies of his predecessor, he implemented sweeping economic reforms that he believed would get the Mexican economy back on track. President Salinas' policies resulted in a significant liberalization of Mexico's domestic economy. He privatized hundreds of state-owned enterprises, liberalized foreign investment laws, deregulated the financial services sector and implemented across-the-board reductions in tariffs and non-tariff barriers to trade. In June 1990, he proposed the North American Free Trade Agreement (NAFTA) to President George H. Bush, which was ratified in January 1994.

To ease investors' fears of currency over-valuation and subsequent currency risk, the Salinas administration also implemented a graduated, fixed exchange rate policy (or "crawling peg"). In what Crandall, Paz and Roett (2005) described as "the linchpin" of President Salinas' macroeconomic plan (p. 69), the "crawling peg" allowed for the peso to gradually depreciate daily against the US dollar by a specified amount. This policy eliminated exchange rate variability, making it easier for businesses to determine the exchange rate for profits made by investments in Mexico. This ultimately facilitated foreign direct investment (FDI) in the country, helping stimulate growth in Mexico's economy.

In 1994, NAFTA was launched and Mexico began to experience the economic benefits of increased trade with its two North American partners. During this time, President Ernesto Zedillo

Ponce de León was elected into office, and Mexico was once again struggling with the effects of a fixed exchange rate. The exchange rate put in place during the Salinas administration held the peso at artificially high rates, and prevented it from depreciating even as Mexican reserves of US dollars dwindled. As a result, Mexico began to struggle with a significant and unsustainable current account deficit.

In an attempt to address the dwindling reserves, the Zedillo administration announced a devaluation of the peso by 15 percent. Unfortunately, this sparked massive herd behavior as investors took the devaluation to mean that Mexico was facing economic hardship. According to Crandall, et al. (2005), “in the 48 hours between the announced devaluation and the forced devaluation of the peso, Mexico’s foreign reserves dropped by \$4 billion [...] investors sold pesos in droves and the nominal price of the peso almost immediately plunged from three pesos per dollar to six per dollar” (p. 69).

As Mexico sought to stem the panic in its own economy in 1995, the peso crisis created a contagion effect that spread throughout Latin America and some parts of Asia in what became known as the “Tequila Effect.” According to Peter Kingstone (2013),

“Macroeconomic imbalances – even modest ones – led investors to conclude that the government could not maintain the value of the currency, triggering a run. Runs on the currency quickly turned into stampedes as foreign and domestic investors fled. In most cases, a contagion effect occurred as investors retreated from emerging markets in general. The ensuing social consequences, such as profound deepening of poverty, were devastating” (p. 67).

The flight from emerging market assets significantly affected the economies of Argentina, Brazil, India, Pakistan, Turkey and Venezuela (World Bank, 1997), shaking investors' confidence in emerging markets as a whole.

President Zedillo's administration spent most of its term trying to dig Mexico back out of economic hardship. He abandoned the "crawling peg" exchange rate since the treasury no longer had the reserves to maintain a fixed value for the peso. This initially caused the peso to devalue by more than 50 percent in the first six months of the crisis (Villarreal, 2010, p. 4), but eventually the exchange rate leveled out to a rate that was significantly lower than the fixed rates. Crandall, et al. (2005) noted "the Zedillo administration's move to a floating-exchange-rate system cured one major headache of the Mexican authorities—devaluation [...] central bank authorities no longer feared a disruptive currency crisis provoked by massive capital flight" (p.72).

The administration also made concerted effort to reduce Mexico's exposure to crises via credit channels by working to reduce the country's overall debt. As oil prices started to increase at the end of the 1990s, Zedillo used the extra revenue to pay off \$3 billion dollars of debt owed to the IMF, three years ahead of schedule (Crandall, et al., 2005). By 2001, the economy was stable with significantly reduced debt and near-balanced fiscal budget. Yet the economy still faced stagnated growth caused by the trade recession that followed the burst of the US dot com bubble.

While the floating exchange rate had helped to prevent future situations of capital flight and helped the economy grow swiftly through favorable terms of export trade, it also had devastating effects on Mexico's poorest populations. According to Villarreal (2010), "the peso devaluation resulted in a decline in real income, hurting the poorest segments of the population

and also the newly emerging middle class” (p. 5). Since the effects of the recession were so severe on the domestic economy, the government decided to take steps to restructure the economy in order to lessen the impact of future crises on the poorest sectors of the population.

To do this, the government had to create conditions in which it could move quickly to address rapidly changing economic conditions. With the support of the IMF and the United States government, Mexico set up emergency financial support packages, which would allow the Mexican government to withdraw up to \$50 billion in loans from both the IMF and the US in a time of crisis (Villarreal, 2010, p. 5). By the year 2000, the Zedillo administration’s efforts to stabilize the economy were paying off; growth that year reached 6.6 percent just as the Fox administration took over (Ibid).

Mexico’s Economy 2000 - 2008 – Learning from the Past

At the turn of the twenty-first century the Mexican government pursued policies aimed at liberalizing trade, while simultaneously trying to ensure the stability of the peso. These policies consisted of monetary and fiscal controls to keep inflation low, and free trade agreements to reduce Mexico’s dependence on the United States.

After the debt crisis of 1982 and the peso crisis of 1994-95, the Mexican government had implemented sweeping monetary and fiscal reforms. These reforms included measures to reduce the public deficit through a new balanced budget rule, requiring the government to limit yearly spending to the amount of revenue² brought in each year. According to the Bank of Mexico, the Mexican government had reduced its public debt to 15.8 percent of GDP and it was running a budget surplus of 0.1 percent of GDP by 2006 (Annual Report, 2010, p. 71).

² Government revenues in Mexico consist of a combination of tax and oil revenues.

In addition, the government had also adopted a floating exchange rate in order to avoid the situations that created the peso crisis of 1994. According to Sidaoui, Ramos-Francia, and Cuadra, this allowed the currency to shift in value based on the market demand for pesos, with the added benefit of significantly reducing inflation in Mexico (p. 281). The floating exchange rate also had the effect of stimulating Mexico's industrial sector by making Mexican goods appear cheaper in the global market. Finally, this stimulus was compounded with an increase in trade brought about by the implementation of NAFTA, as Mexican exports to member countries increased from USD\$50 billion in 1994 to almost USD\$250 billion in 2008 (Villarreal, 2012, p. 16).

After each recession Mexico emerged battered but financially stronger, helping to prepare the country for future instances of investor panic. The financial packages, balanced budget rule, floating exchange rate and reduced foreign-denominated debt were all instrumental in ensuring that Mexico weathered the 2008 financial crisis without inducing a currency crisis. As Porzecanski (2009) concluded, "[2008] may well be the first time since Latin America gained its independence in the early 1800s that a major economic contraction and financial calamity in the industrialized world has not caused a wave of currency, sovereign debt or banking crises in the region" (p. 5). Yet, it became apparent that Mexico was still vulnerable to negative investor sentiment ingrained in the minds of traders after years of repeated currency crises.

In mid-2007, the first signs of stress in the U.S. housing market appeared. Loose credit and an intentional lack of government oversight resulted in an over-inflated US housing economy. In the months leading up to the beginning of the global financial crisis, investors were still confident that Mexico would remain moderately unaffected due to the sound monetary and fiscal policies the government put in place after the debt and peso crises of the eighties and

nineties. Yet when the U.S. investment bank Lehman Brothers was forced to declare bankruptcy, affecting several other financial companies around the globe, the international economy entered a state of panic. Investors and companies around the world pulled their money out of the markets because they could not be certain which companies would be affected by the investment bank's collapse.

Mainstream media narrated the effects of the week following Lehman's failure, restating the market's pessimism, but providing no more concrete information about the absolute effects that the failure's fallout would have on specific assets. New methods of sharing information and trading assets meant that the news was shared and acted upon instantaneously, long before official parties had a chance to provide facts about the true state of asset values. It quickly became clear that the global investing environment to which Mexico sought to reduce its exposure had fundamentally changed, exposing the country to a new kind of crisis that had not existed in past crises— that of the technologically aided information cascade.

Chapter 3: Information Technology and Investment Behaviors

Between the peso crisis of 1994 and the global financial crisis of 2008, the means by which investors gathered information about investments evolved significantly. The introduction of internet technologies rapidly increased both the amount of information available to investors, and the speed with which they could find and utilize that information. The world became digitally connected, facilitating information sharing on a level that made it difficult for governments to censor. The 2008 financial crisis was the first global recession in which news about Mexico's economic vulnerabilities could be shared in seconds, rather than days, using a variety of digital media sources. This new level of scrutiny was not limited to emerging economies and had a significant impact on all of the economies involved in the global credit crunch.

With its proximity to the United States, Mexico felt the brunt of that new scrutiny when the markets in the United States started to falter. While the investment world focused squarely on the US government's actions as the Lehman Brothers investment bank faltered, the week following the bank's failure had global repercussions. As illustrated fully in chapter eight, observers could physically watch the sentiment about Mexico and other Latin American economies deteriorate through digital news and social media publications that coincided with the dramatic drops in currency values. While the primary source of information about these economies came from mainstream news sources (as in past crises), the speed at which the news was shared through social media and online search accelerated the impact that news had on both Mexico's currency and its economy. The following examines the evolution in information technology prior to the 2008 crisis, and how that technology impacted the investment behaviors that affected the value of the Mexican peso in the onset of the global financial meltdown.

The Evolution of Information Technologies

The early 2000s saw the rise of both internet and mobile technologies. Information consumption increased rapidly around the world as the internet and smartphones granted instantaneous access to any information the heart desired. In addition, the creation of search engines provided a means through which that information could be found efficiently, while social media provided a new means to store, share and even create information consumers found to be important. Finally, the proliferation of mobile applications allowed consumers to search, create, share and shop on the go, further liberalizing the flow of information – and sales opportunities – around the world. Together, these technologies changed the everyday behavior of consumers and ultimately, the behavior of investors as well.

Technology and the Brain

Individual consumer behavior changed tremendously with the introduction of internet technology. The new technology revolutionized the way individuals were able to connect and share information, while also providing a wealth of information never previously aggregated on such a large scale for so many people to access freely. Even information written in a foreign language could be accessed by an audience of non-native speakers, thanks to the development of online translation services. Finally, the development of search engines made it easier than ever to find very specific sets of information, by allowing users to search for it using only a few keyword phrases.

Yet, as with all rapid change, the evolution of consumer behavior to information technology had both its advocates and its critics. Proponents of the new technology believed it made society smarter by providing better access to information. Yet skeptics believed that the speed and amount of information people were inundated with on a daily basis were

overwhelming society, causing it to lose the ability to critically analyze texts due to information overload.

Dan Tapscott is one of the major proponents of the digital age. In his book *Grown up Digital* (2009), Tapscott argues that advances in technology have actually made society smarter (p. 30). With the dawn of the Internet, more diverse information is available than ever before; a researcher can now take into account a more diverse set of opinions and sources than he or she may have previously been able to access using traditional sources (p. 44). In addition, Tapscott states that the amount of information available to society has made society more skeptical and critical of the information with which it is presented (p. 80). Thus, he surmises, people are prone to research even more to make sure that the information they have is correct before claiming it to be true.

Tapscott also argues that due to the quickly changing nature of the Internet, people have become quicker to change their opinions and assumptions when new information is presented (p. 80). If the information a person finds turns out to be incorrect, it does not take long for that person to discover his or her mistake and make a course-correction – usually through a quick Google search. The end result, Tapscott explains, is a society that is smarter and will adapt more quickly than ever before to changes in the information environment.

When viewed through the lens of investing, Tapscott's findings imply that investors are more likely to research their investments constantly due to the ease and speed at which information can be gathered. In addition, investors are more likely to be skeptical of the information that they find, causing them to seek out multiple sources to validate the information they use to make investment decisions. Finally, Tapscott's findings imply that investors will be less likely to hold onto investments for long periods of time because information is constantly

changing. Thus, investments would be bought or sold based on the newest information available, rather than loyalty or a company's past performance. Overall, in Tapscott's world, there would be more volatility in stock markets, but investors would be better informed about their investments.

However, critics of Tapscott claim that the very nature by which the Internet presents new information and promotes multitasking is actually making society less intelligent. Due to time constraints and information overload, individuals may be consuming small amounts of information across several subjects at the cost of being able to critically analyze a few texts deeply for their true meaning and implications. Thus, information that sounds "good enough" becomes the information that people believe, regardless if it is from an expert opinion or not.

Nicholas Carr speaks to this phenomenon in his book *The Shallows: What the Internet Is Doing to Our Brains* (2010). Carr's research discusses how the very means people gather information can shape the way they process that information. Claiming to have been born of an analog world, Carr describes the time in which he was able to sit down and analyze the text for extended periods of time. "Once I was a scuba diver in a sea of words," he recalls. "Now I zip along the surface like a guy on a Jet Ski" (p. 7). Carr also notes that this phenomenon is becoming so prevalent that sitting down to read a book has become a foreign experience to some members of younger generations:

For some people, the very idea of reading a book has come to seem old-fashion, and maybe even a little silly – like sewing your own shirts or butchering your own meat. "I don't read books," says Joe O'Shea, a former president of the student body at Florida State University and a 2008 recipient of a Rhodes Scholarship. "I go to Google, and I can absorb relevant information quickly." O'Shea, a philosophy major, doesn't see any

reason to plow through chapters of text when it takes but a minute or two to cherry-pick the pertinent passages using Google Book Search. “Sitting down and going through a book from cover to cover doesn’t make sense,” he says. “It’s not a good use of my time, as I can get all the information I need faster through the Web.” As soon as you learn to be “a skilled hunter” online, he argues, books become superfluous (p. 8-9).

This attitude has found its way into the investing world as well. The very premise of using search engines, social media and even automatic trading algorithms to “cherry-pick the pertinent passages” of breaking news stories means that investors are able to act on new information faster, without actually reading the text thoroughly. This has major implications for herd behavior, since the very means by which information is aggregated and used has the potential to induce herd behavior. In particular, as the global community transitions to an age in which people acquire information from internet sources and search engines like Google, the way they are presented “relevant” search results has the potential to frame the way they perceive the credibility of the information listed on the results page.

Google: Another Kind of Herd-Inducing Algorithm

Like social media, online search has come to play an intricate role in the sharing of information. As the Rhoades Scholar demonstrated, the initial search for new information in the 21st century usually begins with Google. As of 2013, Google is the most popular search engine in North America. According to comScore (2013), the leading authority of internet technology analytics, people living in the United States typed 12.8 billion search inquiries Google’s search bar in August 2013 alone. Those searches represented 66.9 percent of the full 19.1 billion search queries made in the United States in that month. Microsoft’s Bing was the second-most used search engine at 17.9 percent (3.4 billion) of the total search market queries (Ibid).

Google gained popularity as a search engine for the way it organized and made information “searchable.” An individual can find nearly anything by putting a simple query into the search bar, which Google uses to organize access to the pages that are most “relevant” to that person. Google displays information on multiple results pages, ranking information by both relevance and popularity. According to the company, the Google algorithm “rely[s] on more than 200 unique signals or ‘clues’ that make it possible to guess what you might really be looking for” (2012, “Inside search”). These signals include: keywords within the content of a webpage; the timeliness of the content; the geographical region of the user; the amount of clicks the page receives when it shows up on the search results page; and the “bounce back” rate, or length of time a user spends on a page before “bouncing” to a different page.

The Google algorithm also uses a ranking mechanism call PageRank, designed by the company to determine the relative “appropriateness” and credibility of a webpage for a specified keyword. Though the nature of this program is constantly changing, part of its analysis of websites takes into account the number of “link-backs” to a web page by other websites for certain keywords (Brin and Page, 1997). Each “link-back” acts as a vote of confidence from other websites for specific keywords, much like citing sources in a research paper for particular topics. Combined with all of the other 200-plus signals, Google’s algorithm uses a complex weighting algorithm to determine the “rank” of a web page for each keyword or keyword phrase entered into its search bar.

The resulting rank determines what order search results appear to users when a query is entered. However, this method of ranking can lead to information cascades when people using the same keywords to search for information on Google are presented with similarly ranked sets of information. According to information technology researcher Sounman Hong (2012), ranking

is important to the creation of information cascades because “highly ranked information is made more visible to users, assuring an even higher probability of getting online clicks” (p. 70). The higher “click-through” rate (clicks to the page) then reinforces the “credibility” ranking given to the page by the PageRank algorithm, causing it to continue to present that same information for the specified keyword set.

This means at a very basic level, consumers have been “trained” to believe that the most relevant sources of information will appear on the first couple of pages of search results, making it likely that they will cite the same resources when looking up information. This behavior is well documented. According to a recent study by the digital advertising network Chitika (2013), the very first search result in the “organic” or un-paid search listing receives on average one-third of all click-throughs, with the second result receiving a mere 17.6 percent (“The Value of Google Result Positioning”).

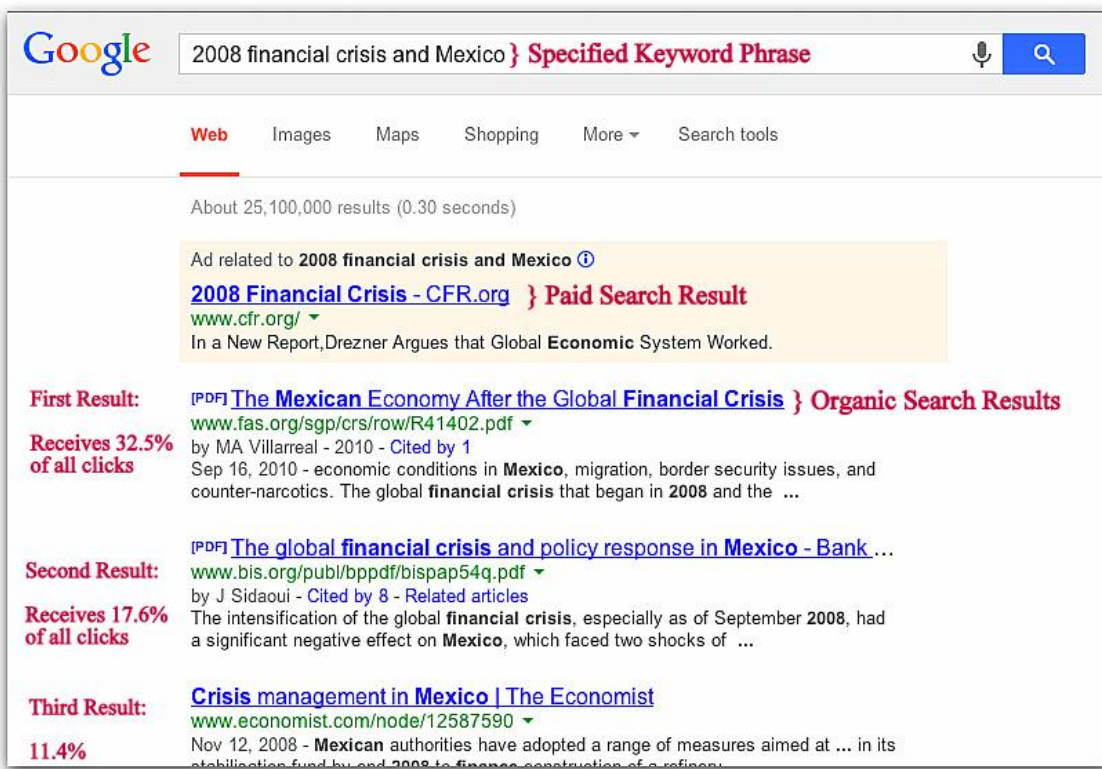


Figure 2 Percentage of Clicks Organic Search Results Receive in Relation to Rank on Results Page
[Source: Screen grab of Google search results page]

When considering the multitude of resources offered for a single search (over 25 million results for the search in Figure 4), the fact that the first three results receive over half of users' attention is a testament to the search engine's potential to unwittingly create information cascades. Unless the user is unusually persistent, Chitika's findings note that most users never move past the first page of results. Overall, the very first page of search results receives 91.5 percent of all clicks, while the second and third pages receive 4.8 and 1.1 percent respectively (Ibid). Thus, despite the great wealth of knowledge made available to consumers through the internet, people still tend to focus on only a handful of information sources in order to avoid information overload.

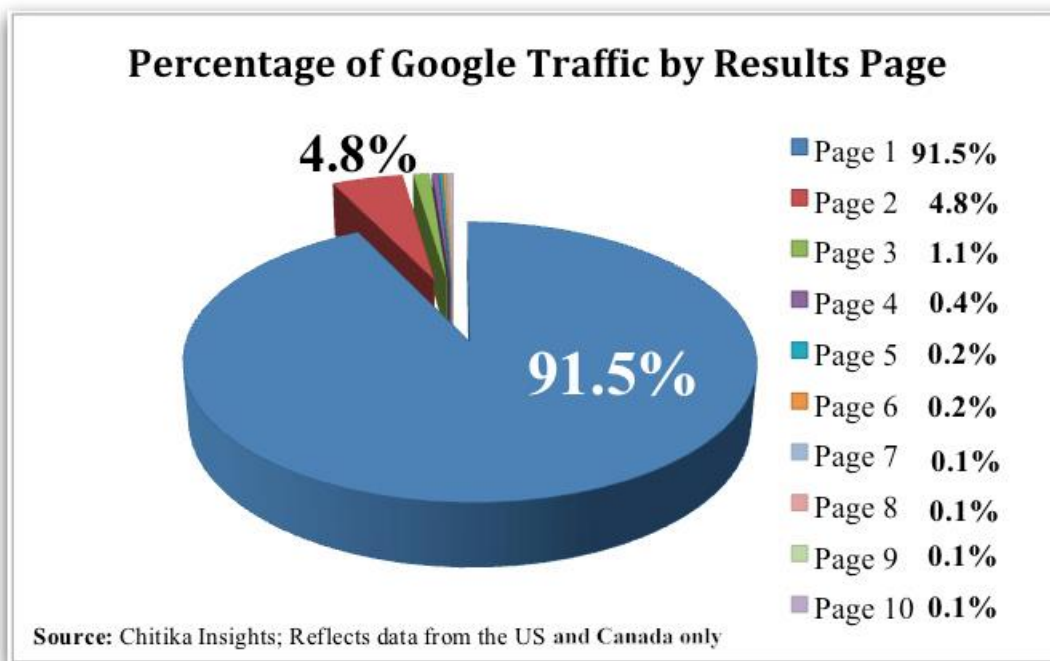


Figure 3 The Percentage of Overall Google Traffic Allocation by Results Page

When bombarded with so much information, so many different sources and so little time to verify the truth, the tendency to herd becomes stronger as people look to the group to determine which source is the most credible. Thus, the role of social media and primary media

sources becomes more important as people seek to limit the noise of the Internet to sources that they deem credible. If a group or culture as a whole decides that one or two particular sources are highly credible, then other people will follow and hold that source be credible as well.

Seeking Faster Information

Prior to the dawn of digital information technology, traditional means of gathering investment information took considerable time and analysis. From Reuters' pigeon and telegraph service, to the telephone and television, investors have constantly sought out faster sources of important, "market-moving" information that they could act on before anyone else. If the information was good enough and found quickly enough, investors could purchase or sell assets before the market price moved to reflect the value of the information change, allowing them to make a profit on the difference. This competition and drive to be first to the market with news is the reason why the United States established laws against insider trading. After all, using information not available to anyone else has the potential to cause asset prices to move so substantially from their original values that other investors in the market could be financially ruined before the information becomes available to them.

Yet even within the confines of regulation, information traders – or those investors who seek to make profits by being first to the market with new information – have constantly sought to create advantages for themselves at the expense of their competitors. The internet not only provided new sources of information that were previously difficult to obtain in the analog era; it also provided investors the ability to search for specific keywords to find the snippets of information most important to them, without taking the time to read whole books or articles. The three most important information technology developments created during this time were

machine “readable” newswires, the social media platform Twitter, and automatic trading algorithms.

Reuters led the way in digitizing mainstream media news, creating both a dot com news hub and a newswire specifically for investors. In 2006, Reuters released two products (names unknown) that allowed machines to “read” *Reuters* headlines digitally for the first time, paving the way for automatic trading algorithms (Thomson Reuters, “Company History”). As a result, investors no longer had to search the internet for breaking news; it was delivered straight to their trading hubs for analysis.

Around the same time Reuters was digitizing news, Twitter was quickly becoming one of the most commonly used social media platforms for investment information. Founded in March of 2006, Twitter functioned as a “micro-blogging” site that allowed people to share updates in 140 characters or less (Twitter, “About”). By the fall of 2007, major news media companies like Reuters were using the social platform to share breaking news headlines with their followers, often accompanying the headline with a link to the full article.

Louis Lovas, director of solutions at OneMarketData, noted in an *e-FOREX* magazine article that the idea of trading based on non-traditional information found using social media is “not new by any means”(Szalay, 2014). While some trading companies who viewed social media with skepticism blocked its use on company computers, tech-savvy information traders increasingly used social media via smartphones as an additional pipeline of trending news.

A market research study by MarketWired, a leading social media analytics, market research, and high frequency trading algorithm firm, confirmed the growing trend of social media use among investors. The study titled, “The Future of Investing and the Great Social Shift” consisted of survey responses from 120 US-based stockbrokers, financial and market

analysts, financial advisors, individual traders and fund managers. MarketWired found 40 percent of all the respondents admitted, “that they were using social media to find [investment] information” (Levine, 2013). Among the millennial generation – respondent 40 years old and younger – 60 percent stated that they frequently used social media to research investments, with 53 percent of them stating that they believed the information they found on those channels to be credible (Ibid). It was not long before companies combined Twitter and the digital newswires to build algorithms that capitalized on all the fast new information.

Shortly after Twitter started gaining traction in 2007, the company OneMarketData created its flagship data analysis tool OneTick that it later combined with a market data platform from a company called Wombat. Together, these two companies were able to provide a trading algorithm program to both aggregate and analyze real-time data from online sources like Reuters digital newswire and social media. These algorithms were able to execute automatic trades with “low-latency,” or human unperceivable delays between finding and acting on the data (The Trade, 2007). According to the *Securities Technology Monitor* (2008), This tool gathered from sources of data including *Reuters*, the Interactive Data Corporation and Wombat, allowing customers “to collect data from equities, fixed-income, foreign exchange and commodities markets” for use in their own high frequency trading algorithms.

HFT Algorithm

Since 2007, companies have been incorporating automatic trading algorithms designed to “beat” the markets by searching “credible” pipelines of news such as Reuters or The Associated Press for market-moving information, via both digital newswires and Twitter streams. Once that information has been found, the program will buy or sell stocks automatically

within milliseconds of analyzing the data. This rapid method of trading has come to be known as “high-frequency trading,” or HFT.

HFT was a well-established trading strategy by the time the 2008 financial crisis started to spread globally. This became evident in 2009, when investment firms Goldman Sachs and UBS (Union Bank of Switzerland) both brought charges against former employees for allegedly stealing proprietary computer code keys to their HFT algorithms. In an article by Katherine Heires in 2009, those HFT algorithms were “the most tactical and strategic weapons on Wall Street” at the time, comprising “many millions of dollars of profits per year.” According to the article, “algorithms account[ed] for over 25% of all shares traded by the buy-side [in 2009]” while “73% of US equity trading volume [was] attributed to the activities of high-frequency trading firms” (2009, “Code Green”). In other words, 73 percent of the trade volume in the US market alone during the crisis could be attributed to computers acting on information found online, rather than trades initiated by discerning human beings.

For information traders who make their living off of “seeking alpha” or market-changing information, algorithms quickly became the only way to keep up with competitors and to turn a profit. “In today’s lightning [sic] fast markets,” *e-FOREX* journalist Szalay states, “microseconds can make a difference, and minutes are a long time” (2014). Yet, for all their profit-generating uses, algorithms have inherent downsides.

The volume of trades initiated by HFT algorithms acting on negative news articles about the price of the Mexican peso could have contributed to an over-exaggerated run against the value of the peso before “experts” with better information could act. With HFTs making up nearly a quarter of the market, the resulting impact HFT sales of pesos would have had on the peso’s market price could have had the effect of making people doubt their own information

about the real economic conditions in Mexico enough to join the flight away from the peso. This would have made the fall in the asset's value more severe. The continuing fall would have created more market pessimism about the peso, even if the true reasons for the fall in value were unclear. Overall, the sheer 73 percent of volume attributed to HFT algorithms could have created enough of a market movement to initiate an information cascade against the peso. This ultimately could have caused the peso's value to fall further than it would have if individuals had acted solely on their own information and HFTs were not part of the market.

In addition, HFTs could have added to the overall uncertainty in the markets during the first week of the global financial crisis by increasing the volatility in the prices of assets it automatically chose to buy and sell based on media sentiment. Thus, in the event that negative information was published about the economy, HFTs could have initiated a "flash crash" that would have negatively affected that economy. While archives of the time during the first week of the crisis make it incredibly difficult to determine if flash crashes were a significant problem during the 2008 crisis, the following provides concrete evidence that these phenomenon do exist, and the potential impacts they can have on the market.

Flash Crashes

To prevent losses, each algorithm is designed to move on the same information that investors believe their competitors will use to initiate trades, in addition to unique but verified proprietary information. This creates systematic opportunities for herd behavior, when all the algorithms initiate similar actions on the same basic information. If the information is negative, algorithms have the potential to create "flash crashes" in the market, where affected assets lose a significant portion of their market value in mere seconds based on information that was gathered from digital sources. Worse, if the information from sources deemed credible turns out to be

wrong, flash crashes have the potential to significantly impact the value of otherwise healthy assets before anyone realizes a mistake has been made.

This is exactly what happened on April 23, 2013. At 1:07 p.m. EST, *The Associated Press* (AP) Twitter account published a tweet stating, “Breaking: Two Explosions in the White House and Barack Obama is injured.” This tweet was sent out to the account’s nearly two million Twitter followers and shared by these followers over three thousand times. In the two minutes that followed the publication of the 71-character message, both the S&P and Dow Jones dropped precipitously, losing over \$136 billion dollars in revenue (Keller, 2013). According to *Reuters*, even stock and bond futures contracts were affected (Selyukh, 2013). This message had triggered the automated selling provisions of HFT algorithms, and their programs were causing the market to crash. Consisting of half of the allowable message characters, rarely had so few words caused such a major impact on the stock markets.

Yet the information in the tweet was not true. Suspicions were raised almost immediately when journalism industry experts started to point out the writing-style inconsistencies in the tweet. They pointed out small details, such as the use of the word “and” instead of the correct AP-style comma, in addition to the sentence-case “Breaking” instead of AP’s usual all-caps “BREAKING.” However, given that this tweet was published just over a week after the Boston Marathon bombing, it took several minutes for the markets to register that the tweet was fake. Once the algorithms picked up news that the tweet was not real, the markets rebounded almost as quickly as they had fallen.

Twenty minutes after the tweet was publish, *The Associated Press* released a statement that its Twitter account had been hacked, and that the company had removed the false tweet. Later it was revealed that the both the main account @AP and the company’s @AP_Mobile had

been hacked by group known as the Syrian Electronic Army, who had used a sophisticated phishing email to glean the account's password credentials. According to *The Telegraph*, the hack was one of many cyber-attacks that week "in a string targeting international media organisations [sic], including the New York Times and The Wall Street Journal" (2013).

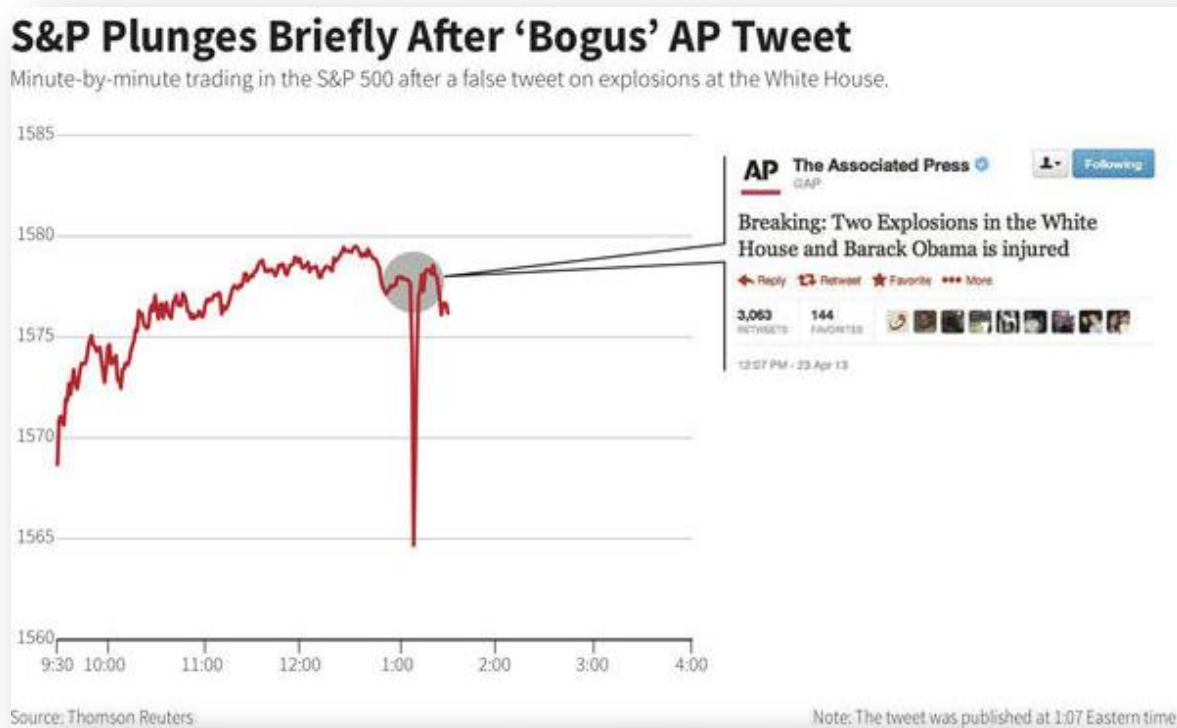


Figure 1 The Effect of the Fake AP Tweet on the S&P 500 [Source: Thomson Reuters]

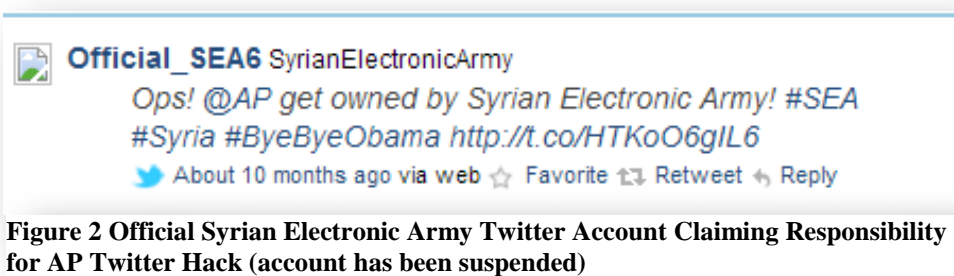


Figure 2 Official Syrian Electronic Army Twitter Account Claiming Responsibility for AP Twitter Hack (account has been suspended)



Figure 3 Official AP Acknowledgement of Hack [Source: Screen grab from AP Corporate Communications Twitter page]

As mentioned, the markets recovered quickly from this “flash crash” because it soon became obvious that information was not coming from a credible source. Yet the markets still moved, indicating the limitations of the trading algorithms that could not make the distinction in the subtle writing differences between the real and fake tweets. The April 2013 flash crash also exposed how reactive the markets had become to information shared via social media and other online sources due to these HFT algorithms.

Ultimately, the April 2013 flash crash ended up being harmless because it happened during a period of relatively calm economic times and was in reaction to “news” that was clearly false. Given that no other news outlet published the same news, even ill-informed investors were not induced to sell off assets in a panic. This meant that markets recovered quickly with no permanent lasting effects.

However, the actions of these algorithms, combined with negative media sentiment and the drive to be first to the market with news, could have triggered large amounts of market volatility during the first week of the 2008 financial crisis. The uncertainty created by the collapse of the Lehman Brother's investment bank, and the subsequent near-failure of other major financial firms created significant market pessimism – a sentiment that was reflected in mainstream media. As articles about the potential, but unproven, vulnerabilities of companies and economies were published by global media sources, the reactions of HFT algorithms reacting to that news could have initiated flash crashes in the values of those assets. The fact that flashes exist means they could have been a contributing influence in the initial, near-instantaneous flight away from the Mexican peso after the announcement of Lehman's bankruptcy.

Technology During the 2008 Crisis

All these advances in information technology prior to the 2008 financial crisis changed the way investors could react to negative events as they were unfolding. Not only could investors quickly find information about the crisis and how it affected their portfolios – the information was pushed to them via digital newswires and social media alerts. They no longer had to make a phone call to initiate a trade based on the new information; they could just go online or execute a trade from their mobile device using an investing app. Thus when a significant amount of uncertainty entered the market the day that Lehman declared bankruptcy, investors were able to respond instantaneously, using the latest breaking news to make investment decisions.

In addition, large investment companies were also able to react to the negative sentiment in the news faster than anyone else through the use of automatic trading algorithms. This meant

that the stock markets reacted within hours of Lehman's bankruptcy filing, rather than days, increasing the sense of urgency and uncertainty present in the markets.

For reasons explained in detail in chapter five, this sudden volatility and uncertainty in the markets caused many investors to become risk adverse. Thus, any asset perceived as risky was liquidated (sold) in an attempt to build up cash reserves in preparation for hard economic times ahead. These sales happened quickly and were often scheduled via the internet even when markets were closed. As a result, markets "froze" or ceased to work, since few people were willing to invest without a guarantee that an investment would survive the crisis. This meant that businesses were unable to get the short-term credit lines they relied on as a source of cash flow to pay bills and employees. Cash – in US dollars to be specific – became both the most demanded asset and the hardest asset to come by. Eventually, when the dollars could not be sourced within US markets, investors began to sell their foreign assets to build up cash reserves.

Given Mexico's past history with global crises/ recessions, the peso was perceived to be a more risky asset, prompting investors to trade the peso for US dollars even though the country had nothing to do with the crisis unfolding in the United States. In addition, pesos were easy to exchange for US dollars because there was a large enough market of people willing to buy pesos to facilitate the trades, unlike smaller Latin American countries such as Costa Rica. As the value of the peso fell, mainstream media published articles about the devaluation through online channels, rapidly increasing the perceived negativity surrounding the peso. Ultimately, volatility caused by pessimistic investors and HFT algorithms reacting to media sentiment could have triggered a herd effect against the Mexican peso, contributing its 25 percent devaluation in the first month of the crisis. The devaluation and subsequent credit crunch caused Mexico's

domestic economy to fall into a deep recession, from which it did not begin to recover until late March of 2009.

Mexico ultimately became the most affected Latin American economy during the crisis. The devaluation of the currency was longer, and the recession deeper than any Central or South American country. Yet, the country's biggest vulnerabilities to the United States were trade related; Mexico had already taken steps to reduce economic vulnerabilities through currency swap lines, flexible exchange rates, reduced foreign-denominated debt and balanced budget rules. In fact, the Mexican government had been strengthening all of the country's macroeconomic fundamentals since the currency crises of the 1980s and 90s. Yet for all the effort put into building up Mexico's economy, the country still suffered even more than the United States – the country that started the crisis.

Ultimately, the crisis Mexico experienced through the first quarter of 2009 could be largely attributed to the behavior of foreign investors who were beyond the control of Mexican economic policies. The coordinated behavior of these investors forced the Mexican government into a defensive position; it had to implement policies and rescue plans to calm the fears of these investors in order to slow the flight of capital leaving the country. And while the government was ultimately successful, the effects of this herd-like behavior were still profound. To better explain why external herd behavior created so many issues for the Mexican economy during the crisis, the next chapter provides the theoretical background of herd behavior study. In addition, it explains the cultural and incentive structures that can induce rational investors to participate in herd behavior during times of uncertainty that will ultimately make them financially worse off.

Chapter 4: The Theoretical Background of Herd Behavior and Information Cascades

Information cascades and contagion effects are both part of the broader theory of herd behavior. As explained previously, the phrase “herd behavior” is a general descriptor used to explain situations in which the decisions of individuals combine to produce coordinated group behavior. Actions that are labeled as herd behavior come in a variety of forms and can be either the result of an efficient distribution of information in the market (positive) or a means by which individuals make less than optimal decisions (negative). Most often used in the negative sense, herd behavior, or the mimicking of others, is a phrase that has come to represent market failures caused by the lack of time and/or will of individuals to gather all the necessary information needed to make a well-informed decision. This chapter discusses the history of herd behavior, the specific types of herd behavior and how they relate to behaviors observed during the 2008 financial crisis.

A History of Herd Behavior Observations

Herd behavior is primarily a psychological concept that has become an important aspect in the study of financial market behavior. In 1869, Scottish journalist Charles Mackay presented the concept in his book *Extraordinary Popular Delusions and the Madness of Crowds* stating, “men, it has been well said, think in herds; it will be seen that they go mad in herds, while they only recover their senses slowly, and one by one” (p. 18). Herd behavior is often used to describe situations in which people make seemingly irrational decisions when caught up in the fervor of “groupthink.”

Yet herd behavior is not always irrational. Economist John Maynard Keynes (1936) proposed that both professional and personal investors chose investments like one might choose a contestant of a newspaper beauty contest. Instead of picking the candidate that they personally

believed to be the most beautiful, individuals would choose the candidate that they thought would win— the candidate that they believe other people would find most attractive (p. 21). Thus in Keynes analogy, investors “seeking alpha” or information-based profits would pick investment assets that they thought would be affected the most by short-term market sentiment, rather than choosing assets they thought would perform best over the long run. Thus, investors make the rational decision to forfeit possible future profits for profits that can be made in the present.

Herd behavior is also not limited to investing. This phenomenon has been used to explain why people in the same geographic regions share similarities in cultures and fashions (Bikhchandani et al., 1992) and why some software programs on the internet are adopted faster than others (Duan et al., 2009). However, its implications for investing have profound cross-border effects. The theory of herd behavior provides a possible example for why, in highly diversified and globalized markets, fund managers will still try to mimic the portfolio mixes of their competitors in order to find the “right” balance between risk and profit (Calvo and Mendoza, 1996). Rather than capitalize on the diverse offerings that globalization provides, fund managers are more like to herd rather take the time to research assets not being bought or sold by their competitors. These behaviors are rational when the cost of gathering all the necessary information outweighs the possible added benefits of making a more informed investment. American moralist and philosopher Eric Hoffer states (1955), “when people are free to do as they please, they usually imitate each other” (p. 21). Ultimately, since information can be communicated through behavior, individuals who herd are simply exercising a means of learning from group norms in order to pick the least risky course of action.

Spurious Versus Intentional Herding

There are two major general classifications of herd behavior as defined by Bikhchandani and Sharma (2001), two of the original developers of the theory of information cascades. First, there is “spurious” herding, a type of coincidental herding, and second, “intentional” herding. Spurious herding, which is also referred to as efficient herding, happens when information is distributed efficiently throughout the market once introduced. If the information is “market-changing,” and investors adjust their strategies and actions to reflect it for the most optimal results, then the resulting shift in market prices indicates spurious herding.

This kind of herding is commonplace, and is what Adam Smith was describing when writing about the “invisible hand” of the market. Bazán and Montes (2011) also found this kind of herd behavior when studying Mexican stock markets. Their research showed that when recently released macroeconomic data about the United States’ economy differed greatly from what investors expected, the Mexican stock markets would react significantly in what appeared to be coordinated actions.

Ultimately they found that Mexican investors were participating in spurious herding when they adjusted their investment decisions simultaneously to realign their strategies to account for the new market conditions, without collaborating with other investors. Given Mexico’s trading ties with the United States, the coordinated movements of the Mexican stock markets were rational reactions to macroeconomic events that could have a significant impact for the Mexican domestic economy. Thus, even though the market moved as a herd, it was merely a coincidental aggregation of reactions to changes in macroeconomic fundamentals.

Inversely, intentional herding – or inefficient herding – occurs when individuals choose to ignore their own information. Instead, they may choose to take a different course of action in favor of using the information that other investors were using when they made their purchase

decisions. In this case, the first movers in the market become critically important because they influence the behaviors of decision makers that come after them. the first mover is a prominent member of the market, like the major investment bank Goldman Sachs, there is an increased incentive to “learn” from the first mover’s behavior, imitating that behavior in an attempt to capture the same “alpha” or information-based profits. As more investors choose to disregard their own information in favor of seeking the same alpha as competitors, the resulting market shift is called a “cascade.”

Three Types of Intentional Herding

There are three major types of intentional herding that are considered common among portfolio managers and financial investors. These are compensational, reputational and informational herding.

Compensational Herding

Compensational herding occurs when the compensation of professional investors is determined by a benchmark that compares the individual’s performance to the performance of a pre-defined group. Given that the individual’s bonuses may depend upon their performance compared to the benchmark, that individual is likely to mimic the actions of the benchmark group to ensure that his or her results are not inferior to the overall group performance. While this strategy does prevent the individual from performing below the benchmark, it also prevents the individual from acting on his or her own information and strategies that might have resulted in larger gains for the company. Also known as the “agency problem,” intentional compensational herding is inefficient because the most profitable opportunities are not pursued due to the threat they pose to possible future individual compensation.

Reputational Herding

Likewise, reputational herd behaviors in the form of peer-pressure, word of mouth recommendations, and social sharing are called “network effects” as they rely on networks for the distribution of information. This type of herd behavior is most commonly found in the conforming pressures of individual investing firms and online social networks where peers judge personal lifestyles and decisions.

These network effects can cause “reputation cascades” – instances where individuals choose to ignore their own preferences and adopt the behaviors of prominent members of the group because they fear that deviating from group norms will damage their personal or professional reputation. Keynes (1936) notes, “worldly wisdom teaches that it is better for reputation to fail conventionally than to succeed unconventionally” (pp. 157-58). This means that individuals are more likely to have their actions be subject to intense scrutiny by their peers if they fail in an innovative way, than if they fail taking the same strategy as everyone else. Therefore the risk of deviating from the herd becomes much higher, especially if risky behavior is rewarded with job termination.

Reputational herding perpetuates when it becomes a rational means of self-preservation. Sharfstein and Stein (1990) describe this situation as the “sharing-the-blame effect,” as observed in the 1987 US stock market crash:

There are a number of settings in which this kind of herd behavior might have important implications. One example is the stock market, for which the following explanation of the pre-October 1987 bull market is often repeated: The consensus among professional money managers was that price levels were too high – the market was, in their opinion, more likely to go down rather than up. However, few money managers were eager to sell their equity holdings. If the market did continue to go up, they were afraid of being

perceived as lone fools for missing out on the ride. On the other hand, in the more likely event of a market decline, there would be comfort in numbers – how bad could they look if everybody else had suffered the same fate? (p. 465)

Fast-forward to the 2007 housing bubble in the United States: once again reputational cascades gained attention as one possible explanation for the seemingly irrational behavior of investors buying risky derivatives known as mortgage-backed securities (MBS). When asked to explain why his investment-banking firm continued to participate in the market for MBSs despite their risk, the then-CEO of Citigroup Charles Prince gave the following explanation of the pressures the firm faced: “When the music stops, in terms of liquidity, things will be complicated. But as long as the music is playing, you’ve got to get up and dance. We’re still dancing” (Nakamoto and Wighton, 2007).

With this creative metaphor, Prince was trying to convey that the company’s customers wanted Citigroup to continue to purchase MBSs because they thought they were good moneymaking investments. If his company refused to purchase the derivatives, its customers would take their money to another company. On the other hand, if Citigroup’s customers suddenly decided that MBSs were too risky, they would also take their cash (what he refers to as liquidity) out of the company because its portfolio was full with MBSs purchased at the customers’ insistence. Prince understood that in the long run his company was in trouble if the sentiment about MBSs ever turned negative, but he could not hedge against the risk (stop dancing) without angering his customers. In the end, the inefficient reputational cascade cost Prince his job and the company its financial stability.

Informational Herding

Finally, the third type of intentional herding is informational herding. Informational herding occurs among unconnected groups of people. This type of herding is the most difficult to empirically separate from the other types and measure, yet it is one of the most important forms of herd behavior to understand. Bikhchandani and Sharma (2001) propose that individuals participate in this type of herd behavior assume that investors who took action before them have better information and demonstrate said information through their actions (p. 280).

Unlike instances of network effects, information cascades occur because groups of unconnected individuals either do not have the time or the access to the information that others in the group have available to them. Therefore, participants in information cascades do not have the opportunity to validate the information that others used to take action against their own personal information to see who has the best information. If the market movements are in striking contrast to the actions an individual would have taken given their own information, uncertainty becomes an issue, creating doubt in the individual's mind. The individual must then choose whether or not to ignore the market movements to stick to his or her own information, or ignore the information he or she has in order to take the same action as everyone else.

Time constraints play a big role in whether or not individuals choose to herd. Banerjee (1992) notes that if individuals are given time to observe all the actions of the market, and other investors are doing the same, then there is enough time to gather the necessary information to make the most optimal decision. However, if the opportunity costs of waiting (i.e. the loss of investment returns) increase with each moment a decision is not made, investors may decide to herd to prevent short-term losses. Banerjee (2001) writes, "To see the intuition behind this result, note that it is the marginal and not the absolute value of information that matters in the decision of whether or not to wait" (p. 815). In a time crunch, investors may decide that the marginal

“vote of confidence” given to an asset when several people buy into it is “good enough” information about the asset’s quality to justify purchasing it.

When time constraints and large amounts of uncertainty are an issue, fear can make the tendency to herd even stronger. According to neuro-economist Paul Zak, “our brains are really wired to accept the group opinion of the world [...] when you see millions of people in the market essentially freaking out, that spills over into your brain and you get this impulse to do what everyone else is doing” (As quoted in Fox, 2008). Ultimately when uncertainty, fear and time constraints combine, it makes it difficult to maintain individuality. People end up joining the information cascade when they would have been better off relying on their own information.

Thus, the assumption that first movers have larger quantities of good quality information that allows them to take swift action is the main reason why informational herding can be so inefficient. By choosing to follow the behaviors of previous, unknown investors, a person is assuming (A) those investors have better information; (B) they made the correct choice that optimizes returns and reduces risk; and (C) the market concurs with those assumptions because “everyone else” is making the same decision.

However, as Banerjee (1992) notes in his “Simple Model of Herd Behavior,” making the decision to follow the actions of others at the expense of one’s own knowledge further robs the market of useful information, making each subsequent decision less valuable to the next decision maker. Eventually an “information cascade” is triggered, where “we find that in equilibrium the reduction of informativeness [*sic*] may be so severe that in an ex ante welfare sense society may actually be better off by constraining some of the people to use only their own information” (Banerjee, 1992, p. 797). Simply put, in a market where everyone mimics each other, no real information is transmitted through their purchasing actions. Consequently, if the first few

individuals to make the investment decision were working from incorrect information (or no information at all), the resulting cascade can cause everyone to also make the wrong decision. This not only causes each investor to become worse off, but may also cause massive consequences in markets as large quantities of resources are misallocated.

Information cascades tend to be short-term in nature because of the constant introduction of new information that overrules the assumptions made about other investors' behaviors. As such, Bikhchandani and Sharma (2001) note that behavior that causes information cascades "is fragile, in that it may break easily with the arrival of a little new information; and it is idiosyncratic, in that random events combined with the choices of the first few players determine the type of behavior on which individuals herd" (p. 284). Since the introduction of new information causes individuals to make decisions that break away from the information cascade, others observing that behavior might infer that new information has entered the market and initiate a cascade in the opposite direction.

If the information cascade is triggered by automatic trading algorithms, the cascade can break in a matter of minutes, depending on how fast new information enters the market. In high frequency trading (HFT) the phenomenon where a cascade is triggered but breaks a few minutes later is called a "flash crash" – aptly named for the sudden crash in asset prices that the cascade causes. In the end, the presence of information cascades and intentional herding have the potential to increase volatility in markets as individuals, companies and algorithms representing large sums of assets swiftly reallocate their wealth among "trending" investments.

Ultimately, some sort of "information" introduced to the market triggers information cascades. This information can be a change in macroeconomic fundamentals (i.e. the economy is experiencing a recession), but it can also be a general feeling or sentiment portrayed in the

markets. In periods of high uncertainty, where there is very little information about why the market is reacting the way it is or how that reaction will affect investments, sentiment plays a much bigger role. The sentiment conveyed via mainstream and social media can change how investors perceive the future prospects of their investments, either making them more hopeful or more pessimistic and risk adverse. The following explains research about the effects of media sentiment on market volatility, and how sentiment from foreign media sources has affected Mexico's economy in the past.

Chapter 5: Studies of Volatility, Media Sentiment and Self-Fulfilling Panics in Mexico

There has been extensive research on the link between media coverage and financial market movements since the gyrations of US stock markets in the late 1980s. The stock market crash of 1987 challenged some of the assumptions of the efficient markets theory of economics presented by American economist Eugene Fama (1970), with particular respect to asset prices and the information that they convey. The basic premise of Fama's theory states that market prices reflect all the information available at that specific point in time. Prices are "efficient" when they instantaneously reflect new information that has become available to the public. Thus, if new negative information about an asset is released in the market, the price of the asset will fall immediately in response, reflecting the new fundamental value of the asset. This theory assumes absolute objectivity, that investors will only make decisions based on the information available in the market, regardless of the sentiment in which it is presented. This leads to the hypothesis that asset prices in markets only move when new information is presented, and represent an objective re-adjustment of market expectations.

Cutler, Poterba and Summers of the National Bureau of Economic Research were some of the first researchers to empirically test the efficient markets hypothesis in their paper "What Moves Stock Prices?" (1989). Their research came in the wake of the 1987 US stock market crash, a period of economic history that could not be explained by a fundamental shock to the market. There were no major non-economic events, such as elections or foreign conflicts, and there were no new changes in macroeconomic fundamentals, such as inflation or interest rates; yet, the market still crashed.

In response, Cutler et al. sought to understand if the 1987 crash was unique, or if most market movements were at best loosely linked fundamental shocks. Using highly structured

vector autoregressive models for seven types of macroeconomic fundamentals³ and a less structured comparison of return regressions to historical data and new events, they studied the overall stock market's performance from 1926 to 1985. They then used an analysis of contemporaneous market movements to study the robustness of their analysis of the historical market movements. In doing so, they found that shocks or changes in macroeconomic fundamentals only accounted for eleven percent of the stock market movements during the same time period (p. 7). When using a less structured analysis, comparing the regressions to historical events, Cutler et al. found that fundamental shocks still only accounted for 29 percent of the market volatility (p. 10). At best, major news events could explain market movements only 50 percent of the time, but the authors cautioned that this number could be an overstatement due to the limitations of the less-structured analysis (ibid).

Cutler et al. then compared the top 50 one-day gains in the S&P index to the *New York Times* account for the fundamental changes that explain those gains. They found that in most of the days, it was very difficult to attribute a fundamental change as the reason for the gain, noting that on several of those days the *New York Times* even reported that there was no known cause for the market movement (13). Overall, they found that publically available information about fundamental shocks could, on average, only account for a third of the market volatility present on any given day in financial markets. That meant that two-thirds of the volatility present in markets was not the result of new, tangible facts, but rather something else.

³ Cutler et al. examined seven major macroeconomic variables for their study: real dividends, industrial production, monetary supply, long-term interest rates for corporate bonds, short-term interest rates for Treasury bills, the Consumer Price Index (CPI) inflation rate and stock market volatility.

Economists Campbell, Grossman and Wang (1993) explained through their research that this two-thirds phenomenon could be attributed to what they called “non-information traders” or investors that chose to trade assets for reasons other than changes in market fundamentals. Though their research did not explain why these “non-information traders” chose to trade, they were able to provide a direct correlation of their actions to the unexplained two-thirds volatility isolated by Cutler et al (1989).

Tetlock (2007) sought to explain why these “non-information” traders decided to trade, even when the fundamental value and facts about an asset had not changed. He found that in times of uncertainty, these traders became more risk adverse or pessimistic about the short-term future prospects of an asset, prompting them to sell to “rational arbitrators” at a discounted price. He also found that these actions were based more on sentiment – how the investor *felt* about the asset – than a tangible change in the asset’s value, and that the sentiment often reflected the sentiment of the recent news publications. Realizing that news media played a significant role in the decisions of these traders, he redefined “non-information traders” as “noise traders” – investors that make decisions based on the “noise” or information published by mainstream media.

Using a quantitative content analysis program called General Inquirer (GI), he was able to prove a direct link between the sentiment of financial news media publications (i.e. *The Wall Street Journal*) and volatility trends in the market. He found that the link was particularly strong when the use of pessimistic vocabulary in media articles affected market movements in what he coined as the “pessimism factor.” “High levels of media pessimism robustly predict downward pressure of market prices,” he writes, “followed by a reversion to fundamentals” (p. 1140). What Tetlock describes as a downward pressure in prices followed by a return to the original prices is

the very definition of an information cascade. Uncertainty and pessimism present in news media causes noise investors to become more risk adverse, which then causes them to seek out liquidity by selling what they perceive to be risky assets until the uncertainty is resolved. This belief is based on the sentiment they hear from media sources and the actions of other investors that they observe in the markets. Once there is a better understanding of what is going on in the market and how it will affect other assets, these noise investors begin to purchase assets again, causing the prices to stabilize and return to fundamental values.

The interconnectedness of markets through globalization facilitates noise traders' desires to move their assets from one country to another during times of uncertainty. Latin American economists Calvo and Mendoza present a case study of Mexico's balance of payments problems during the 1995 tequila crisis, proposing that fund managers had an incentive to switch from buying to selling Mexican investments at the slightest negative rumor because it was easy. The globalized economy presented them with so many other options that it did not make sense to invest a lot of time in researching the rumors' validity; they could just move their money to other countries that were perceived to be less risky. As a result, Calvo and Mendoza (1996) stated, "outcomes in which the equilibrium response to news is a self-fulfilling panic become plausible, and the behavior of policy-makers becomes as important as their policies (i.e. a poorly-handled devaluation can have disastrous effects)" (p. 14). Self-fulfilling prophecies of crisis are particularly plausible in periods of high uncertainty, such as the uncertainty that a global financial crisis creates.

In addition, Calvo and Mendoza (1996) propose that the increase in costs of gathering thorough information on so many different investment options also increases the incentives to mimic the strategic behavior of other investors by trying to copy their portfolio mixes – a

strategy known as “strategic complementary.” An example of this exists when a company tries to mimic the portfolio mix of Berkshire Hathaway, the company that Warren Buffet partially owns and invests in, in an attempt to make the same kinds of profitable returns that the company has historically made. Whenever Berkshire Hathaway makes a decision to buy or sell a stock, the company participating in strategic complementary would also buy or sell the same stocks.

On an international scale, strategic complementarities among currency investors means that each group of investors with highly diversified portfolios are likely mimicking each other’s behaviors in order to maintain the same portfolio mix of currencies as everyone else. While this ensures the portfolios are engaging in less risk according to the perceived information in the market (the behavior of others), this exposes each country to the very real and detrimental risk of capital flight as large amounts of available capital are moved from “risky” countries to “less risky” countries during times of uncertainty. Thus the sources of information that these investors rely on to make their investment decisions become incredibly important to the overall wellbeing of the economies in which these groups invest.

Yet, Professor Alfuentes Ayala (2011) of the University of San Marcos in Peru notes that strategic complementarities reduce the total amount of information about the countries available in the market, making it possible for rumors to become market-moving events:

La globalización reduce los incentivos para recolectar información específica del país e incrementa la probabilidad que los fondos que se preocupan de su performance relativo elija el mismo portafolio. Consecuentemente pequeños rumores pueden inducir un comportamiento de manada y mover la economía a una crisis de balanza de pagos (p. 13).

Globalization reduces the incentives to collect country-specific information and increases the probability that funds preoccupied with their own relative performance will choose the same portfolio. Consequently, small rumors can induce herd behavior and move the economy into a balance of payments crisis. [L. Vachalek translation].

If investors fail to take the time to become experts in the countries in which they are investing, they will be unable to identify inaccuracies in the information being presented as “breaking” news. Instead, they will be more likely to be swayed by media sentiment, simply moving their money out the countries perceived to be the most negatively affected.

Thus, the dangers of information cascades for emerging economies like Mexico are two-fold. First, since information cascades represent periods where trades are made based on sentiment rather than fact, the outcome of the cascade is largely beyond the control of the emerging economy’s government. While the government can manage the macroeconomic fundamentals of the domestic economy in the form of debt levels, inflation targets and regulation, Cutler et al. (1989) convincingly argued that those actions would only affect a third of market price volatility. The other two-thirds of the volatility would be based on investors’ perceptions of the economy’s ability to withstand periods of uncertainty or crisis, a perception according to Tetlock (2007) that would also be largely influenced by media sentiment.

For Mexico, this meant that during periods of uncertainty such as the 2008 global financial crisis, investors would base their assumptions on the outcomes of similar crises in the country’s past, in addition to any sentiment presented by the media. As demonstrated in the historical background section of this paper, Mexico’s economy traditionally suffered severe currency crises after global recessions, resulting in a pessimistic outlook on the country’s ability to withstand future crises. Thus, in a time of uncertainty, the default media sentiment about

Mexico would be negative, despite the steps the government had taken to strengthen the country's macroeconomic fundamentals and reduce the domestic economy's exposure to external crises.

Second, an information cascade could create balance of payment problems for Mexico as traders withdraw investment capital and dump their currency holdings. If the cascade is severe enough for a long enough period of time, the sentiment-based herding could trigger a real financial crisis within the country due to a lack of available credit and currency devaluation. The fear of a crisis in Mexico then becomes a self-fulfilling prophecy, causing the "rational" non-noise traders to join the herd in reducing their Mexican holdings because a crisis actually starts to develop. Latin American economists Chang and Velasco explained this scenario in their paper "Financial Crises in Emerging Markets: A Canonical Model" (1998):

If a bad shock brings the economy to the region where runs are possible, the harmful effects of the bad shock will be multiplied when, in addition, a run actually takes place. It may be a plausible conjecture that such scenario would arise because (loosely speaking) the bad shock makes depositors and bank creditors *pessimistic*, in the sense of expecting a run when one is feasible. Such a story, we argued at the outset, is reminiscent of events in Mexico in 1994 and East Asia in 1997, in which moderate shocks (higher world interest rates in the Mexican case, dollar appreciation and slow Japanese growth in Asia's) triggered major financial crises coupled with large contractions in economic activity (p. 31).

This means that during the 2008 financial crisis, a period of time in which Mexico was vulnerable to a trade recession through its heavy dependence on the US for export trade, pessimistic sentiment could have made the expected recession more severe. As the data analysis

section will show, an information cascade early on in the crisis could have actually caused Mexico to experience economic contractions sooner and more severely than it might have in a simple trade recession. By creating enough of a run on the peso and other Mexican assets, an information cascade could trigger a deeper financial crisis.

The next section analyzes media and foreign exchange trading data to identify this kind of cascade-like behavior against the Mexican peso in the 2008 global financial crisis. By first identifying the conditions in which information cascades are most likely to be present, this thesis then examines if the severe economic contraction Mexico experienced in the first two quarters of the crisis could indeed be the side effect of investor sentiment rather than poor macroeconomic fundamentals.

Chapter 6: Challenges, Assumptions, Data, Hypotheses and Observations

Challenges and Assumptions

There were several challenges in isolating possible instances of information cascades in the market for the Mexican peso during the 2008 crisis. The first challenge presented in the study of foreign exchange was the issue of periodicity, or lack of natural breaks in the market data. Since markets for foreign exchange never actually open or close, comparing “days” of foreign exchange closing prices becomes difficult. To address this issue, this paper utilized data of peso transactions from the CME Group (Chicago Mercantile Exchange), which functions as a foreign exchange market in the United States. Data of trades completed through this exchange provide a small snapshot of the overall market conditions that mimics the total peso trades completed in the world. Using data from this exchange also created periodicity since the exchange only operates during normal business hours, closing on evenings, weekends and US holidays. In utilizing this data, it became possible to compare “days” of trading with daily headline news.

The second challenge to finding information cascades was creating distinctions between spurious and intentional herding. It is nearly impossible to separate the two empirically without exhaustively interviewing market participants as they were making decisions during the crisis. Therefore, this paper used a specific set of criteria and assumptions to isolate periods of time where there was a high probability intentional herding was taking place.

To determine if any information cascades occurred during the 2008 financial crisis, data on periods of extreme asset price movements were measured against the following criteria and assumptions. First, because information cascades are assumed to occur during periods of uncertainty where the true value of an asset is unclear, the drop in the asset – or in this case, the price of the peso – had to be both severe and unexpected. This meant that the economic and

political conditions of Mexico had to appear relatively stable and unchanged, ensuring that the cause of the price drop was purely external in nature (i.e. outside of the control of the Mexican government).

Next, assuming information cascades occur quickly before information about actual conditions becomes available, the price drop of the peso had to occur within hours of the change in market sentiment. This drop indicated that the sale of the peso was reactionary, rather than rationally based on facts about the real effects of the event on Mexico's economy. This also ensured periods of gradual, informed readjustments in the price of the peso were excluded, thereby increasing the probability that the behavior observed in the market was intentional herding rather than spurious herding.

Third, it was assumed that media plays a critical role in perpetuating an information cascade by providing timely, but ambiguous updates about the price drop that publically recognizes the fear surrounding the asset. These published observations about the price drop serve to convince other investors in the market to join the herd out of fear. Fear causes these once rational investors to believe that the "first movers" may have had better information, as indicated by their decision to sell the asset. This causes those investors to ignore their own information and to sell the asset, despite the fact that the true value of the asset has not appeared to change.

In order to perpetuate the intentional herd behavior, information about the price drop had to come from a reputable source that was both timely in its publications and widely accessible to decision makers through multiple information channels. For the purpose of this research, headlines and tweets from Reuters were utilized to provide a narrative of the crisis as it happened, in addition to providing the sentiment of the markets. Reuters has traditionally filled

the role as the go-to resource for breaking financial news, and it maintains its reputation of being the timeliest source of investment information by providing news through multiple platforms. These platforms include print publications through traditional media partners and online publications via its website, blog and social media feeds.

Reuters was also chosen as the main source of news about market sentiment during the crisis because of its direct ties to investment markets. In 2005, the company partnered with CME Group to link “sell-side traders in the interbank [*foreign exchange*] market to CME’s eFX market,” thereby creating Reuters Trading for Foreign Exchange (*Thomson Reuters*, “Company History”). The following year, Reuters led the way in automated trading by creating products to help machines “read” news headlines published through a digital newswire (ibid). Therefore, automated trading algorithms that used Reuters products for the purpose of foreign exchange trades in CME markets would have “read” *Reuters* headlines published during the crisis and factored that information into trading decisions.

Finally, according to a Pew Research Journalism Project (2009) on the financial crisis, Reuters acted as the top online news source for information about the crisis. According to the study, “About two-thirds of Reuters’ leading news coverage from February till early July [2009] was economy-related, more than double the level in the [online] media overall” (p. 6). In addition, Reuters was the only major source of mainstream financial media broadcasting its news through Twitter during the crisis, with the exception of the more US-focused Wall Street Journal. Thus, individual investors looking online for quick information about the crisis would have found most of the available information through Reuters.com and three of the four active Reuters Twitter handles. Occasionally, other major finance news sources were also included in the data tables as pertinent articles were found.

This data was then compared to CME Globex foreign exchange data for the Mexican peso. Three separate months of exchange data was used during the analysis: September 2008 – the beginning of the global crisis, December 2008 – when the sentiment about Mexico’s future prospects were most negative, and March 2009 – when the devaluation of the peso ceased. The data from September and December were used for herd behavior analysis, while the data from March 2009 was used as a benchmark to show the full effect of the depreciation. This data was then compared to the sentiment of the Reuters headlines to test the following hypotheses.

Hypotheses

The development of the hypotheses began with a general observation of the overall market trends for the Mexican peso and the US stock exchanges. As previously noted, it was observed that the Mexican peso lost nearly 25 percent of its value from September 22, 2008 to October 16, 2008. Thus, the initial hypothesis was that the sharp drop in the price for the peso could indicate the presence of an information cascade triggered by negative sentiment in mainstream media. Since the visible drops in the price of the peso correlated with major events during the crisis – such as the bailout of the government-sponsored entities Fannie Mae and Freddie Mac, the Lehman Brothers bankruptcy and the bailout of the US auto industry – these events were selected to be analyzed for further evidences of information cascades.

The second hypothesis was that negative media sentiment would be closely correlated with downward pressure on the price of the peso. Once an information cascade was identified in hypothesis #1, daily *Reuters* headlines mentioning the event, the crisis, the effects on Latin America in general, and mentions of the Mexican peso specifically were gathered and analyzed for sentiment. This sentiment was then compared to the foreign exchange data from CME Group to determine if there were any observable correlations in the peso’s volatility.

Observations

The first step in the analysis was isolating periods or events during the crisis that mimicked information cascades. As stated in the hypotheses, three major events were selected for their potential to create conditions for herd behavior in the market for the peso. These events were: (1) the week after the rescue of the government-sponsored entities Fannie Mae and Freddie Mac; (2) the entire week after the bankruptcy of the US investment bank Lehman Brothers; and (3) the week after the “Big Three” US automakers received bailout funds from the US government.

The first event – the rescue of Fannie and Freddie – was a turning point in the US credit crunch. The fact that the US government had to take control of these two entities because of the overwhelming risk that mortgage-backed securities (MBSs) had added to their balance sheets meant that similar assets held by other investment companies in the market were more risky than previously perceived. This was the first major introduction of uncertainty to the market that affected markets outside of the United States, and caused investors to become more pessimistic about the value of the assets on the books of other investment firms.

The bankruptcy of the Lehman Brothers investment bank was chosen as the second event because it represented the official transition of the US credit crunch into a worldwide financial meltdown. The bankruptcy on September 15, 2008 signaled to investors that the US government was no longer going to guarantee the rescue of companies that made poor investing decisions, causing investors to become significantly more risk adverse. As a result of the uncertainty, investors began to build up cash reserves, while also demanding that companies they invested in do the same.

Finally, the bailout of US automakers was chosen as the last event for three reasons. First, the fact that the companies needed help demonstrated how uncertain the markets had become,

making it very difficult for these companies to secure credit lines and sell cars. Second, all of the “Big Three” automakers had significant factory operations in Mexico, meaning if they failed, Mexico’s domestic economy would be directly impacted. Finally, this event was chosen because it took place in December 2008, right when pessimism surrounding Mexico was at its highest with a *Forbes* cover story calling the country “The Next Disaster” (Bogan et al, 2008).

Hypothesis #1: Identifying Information Cascades

To determine if the market reactions to these three events could qualify as information cascades, they were measured against the three assumptions about information cascades laid out in chapter seven: (1) the devaluation of the peso had to be severe and unexpected; (2) the devaluation had to happen within hours or a day of when the major event took place; and (3) the media had to provide timely, but ambiguous, updates about the devaluation using pessimistic vocabulary to convey the risk aversion of the market.

The Government Takeover of Fannie Mae and Freddie Mac

September 2008 represented the transition of the US credit crunch into a global financial crisis. This was also the month that Mexico began to feel the effects of the uncertainty in the financial markets of its Northern neighbor.

Prior to September, the outlook for Mexico was very positive. According to the OECD (2011), public debt was low at approximately 30 percent of GDP, while growth was above the OECD average (pgs. 153-154). The peso had also appreciated to historical highs of roughly 10 pesos to every 1 US dollar (Banco de México, n.d.). Despite the on-going drug war, the economy was growing, and Mexico was seen as an excellent investment for companies looking to capitalize on the free trade provisions of NAFTA. Thus, any devaluation of the peso at this point in time would have been sudden and unexpected, meeting the criteria of assumption one.

On September 7, 2008, the US government announced the takeover of the government-sponsored entities Fannie Mae and Freddie Mac, organizations that had played an integral role in the creation and sale of MBSs. There had been significant uncertainty in the market about whether the organizations would be rescued and what kind of risk their failure posed to other financial institutions. Their rescue by the government prevented all-out panic, but it also caused investors to take a hard look at the investment banks that had made billion-dollar profits from the trade of MBSs.

The growing uncertainty tightened credit lines, as investors became more risk adverse. Should the markets falter, cash was going to be the most important asset, causing traders to divest what they perceived to be their more risky assets. This caused the peso to devalue slightly from September 8th to September 11th, losing a total of 1.5 percent of its value in three days (CME data, “Average Floor Close Prices” Table). According to Reuters (2008a), “the peso retreated as investors questioned whether the bailout would provide much more than a temporary floor under battered financial markets.” A concern about the vulnerability of Mexico’s export trade to a recession in the US was cited as the biggest reason for the depreciation, which eventually steadied after the 11th, appreciating a slight 0.2 percent.

Overall, the depreciation of the Mexican peso after the takeover of Fannie Mae and Freddie Mac was unexpected and somewhat severe. Given that prior to the crisis the peso gained or lost value at an average of one percent a month, a loss of 1.5 percent in three days was significant. In addition, this devaluation of the peso was reactive in nature, occurring within the first three days after the takeover of the government-sponsored entities (GSEs).

Yet, while mainstream media provided updates about both the takeover and the peso’s fluctuations as they were happening, the articles were varied in their sentiment, trending more

towards neutrality. Only one pessimistic *Reuters* article was published in the three-day depreciation of the peso after the takeover, stating “Mexico’s peso hit by US credit worries, stocks flat” and linking the decline to Lehman Brothers rather than the government sponsored entities (O’Boyle, 2008). While it is possible that the devaluation the Mexican peso experienced after the rescue of Fannie Mae and Freddie Mac could have been the result of risk-adverse traders’ herd behavior, it is not clear if that behavior was linked directly to that specific event.

Instead, it appeared that the biggest concerns affecting the peso’s value were coming from news about Lehman Brothers’ struggle to secure credit, which was creating uncertainty in financial markets. Thus, the devaluation of the peso from September 8th through 11th could have served as a warning to the Mexican government that conditions were prime for an information cascade against the peso, giving the government time to prepare strategies to head off negative sentiment if conditions worsened. However, since the government was not monitoring media channels for sentiment about its economy, Mexico had no way to be proactive in protecting the domestic economy from an external sentiment-based information cascade.

The Lehman Brothers Bankruptcy

The failure of the US investment bank Lehman Brothers was one of the most important events of the 2008 global financial crisis. As mentioned previously, the bankruptcy of this company on Monday, September 15, 2008, signaled to the markets that the US government was no longer guaranteeing with taxpayer-funded bailouts that firms would survive their decisions to take on too much risk. Instead, companies with large amounts of risk in their portfolio would have to find someone in the private market willing to provide them the credit they needed to calm growing fears of insolvency.

The announcement of the bankruptcy sent a shock through the markets. The failure of Lehman meant that the government really was not going to bailout troubled companies, meaning that any number of companies exposed to Lehman or the toxic assets could be the next companies to fail. A commercial trade recession was no longer the central fear of investors. Instead, investors feared the impending financial meltdown, and the very real chance that they could lose everything. In consequence, investors throughout global markets became severely risk adverse and began to divest what they perceived to be risky assets. The markets plummeted, taking with them the value of the peso.

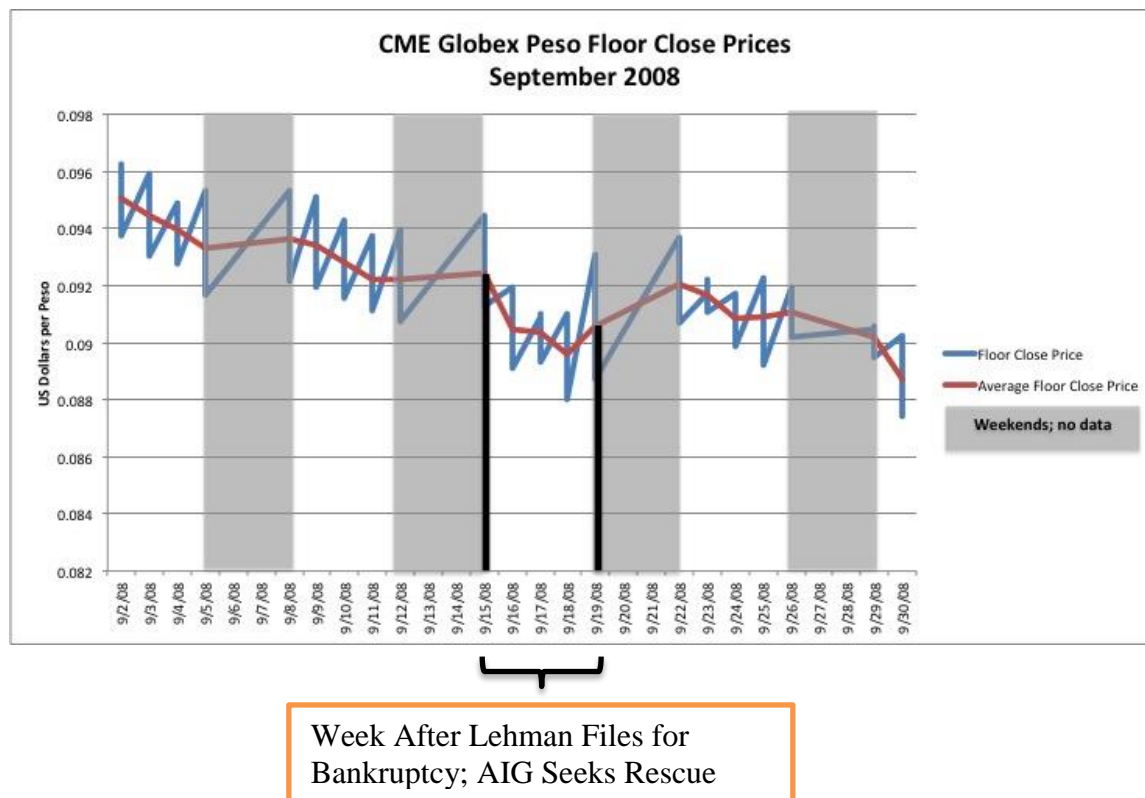


Figure 4 Average Closing Prices of the Mexican Peso in September 2008

At this point, nothing had changed in Mexico or its economy. The peso had been stable leading up to Lehman's bankruptcy, and the country had already re-adjusted its expectations for next-quarter growth to take into account the worsening recession in the United States. Therefore,

the two percent devaluation of the peso from Monday to Tuesday was both severe and unexpected given the country's lack of connections to the toxic assets creating chaos in this US markets. In addition, the peso lost the first percent of its value within four hours of Lehman Brothers filing for bankruptcy, indicating that the drop was more reactionary than rational.

Finally, as will be demonstrated, Reuters published a new update about the unfolding crisis every twenty minutes that day, in addition to other news that was occurring around the world. These updates were "breaking" in nature, providing a description of the sentiment and shock of the markets rather than hard facts about why markets were falling so fast. At least seven of those updates directly addressed the effects of the panic on the Mexican peso and Latin American economies in general. Of the three events initially chosen for closer analysis, the failure of Lehman Brothers, followed by the subsequent panic in financial markets, provided the best representation of an information cascade during the crisis.

US Automaker Bailout

Upon closer analysis, the bailout of the US automakers in December 2008 was immediately ruled out as a possible information cascade for the following reasons. First, by the time the automakers were provided bailout funds on December 19, 2008, the Mexican peso had already devalued from an average of \$0.09445 USD/MX September 2, to an average of \$0.072875, for a total loss of 22.8 percent (CME data, "Average Floor Close Prices" Table). This meant that investors had had three months to adjust their expectations to the real economic conditions within Mexico, conditions that had started to deteriorate significantly into a severe recession.

In addition, on December 4, 2008, *Forbes* magazine released its "Next Disaster" cover story on Mexico detailing the country's economic struggles with the global crisis and the rising

violence of the drug war along its Northern border (Bogan et al). The article was not breaking news, but a researched piece provided an explanation for the deteriorating peso, and conveying resignation rather than fear or uncertainty about the economy's outlook. This meant that anyone who reacted to the news was simply adjusting his or her expectations to the facts presented – a form of rational behavior. Any coordinated market movements at this point would have been, by definition, spurious herding.

Finally, at this point, the markets were no longer reacting wildly to news about Mexico's economic struggles or significantly devalued currency. Instead, the peso fluctuated within a range between \$0.071 to \$0.073 USD/MX throughout the month until the holiday season, when the peso began to devalue once more (CME data, "Average Floor Close Prices" Table).

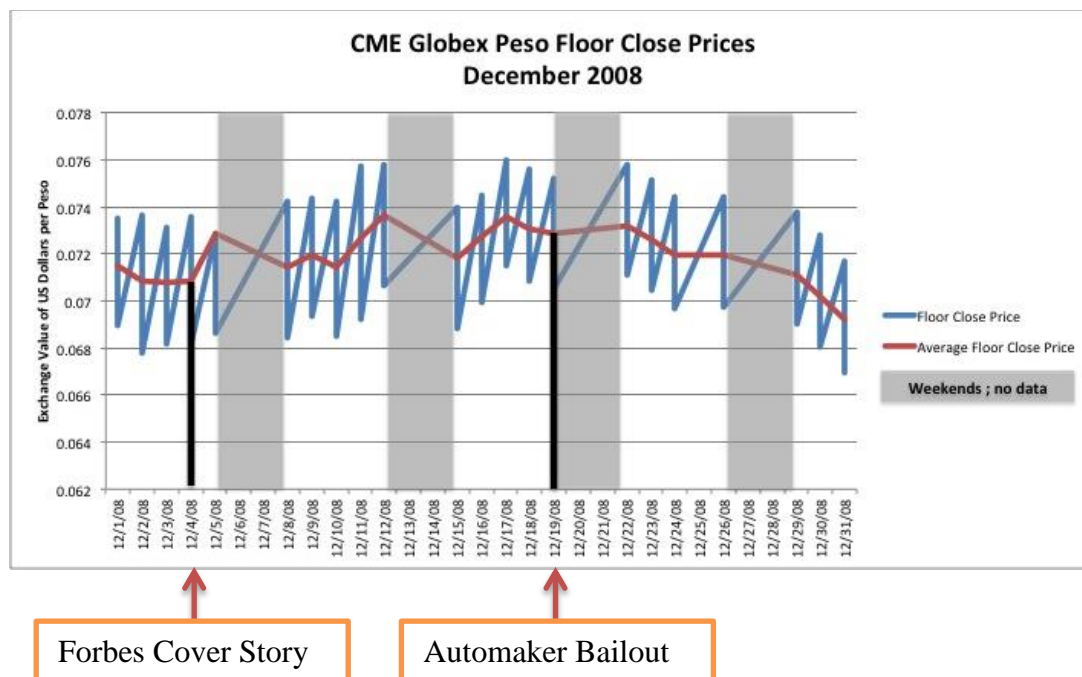


Figure 5 Average Closing Prices of the Mexican Peso in December 2008

Hypothesis #2: Correlations Between Media Sentiment and Peso Volatility

After identifying the information cascade, the next step was to determine if media sentiment presented in the headlines the week after Lehman's collapse was related to the

volatility of the peso. To do this, *Reuters* headlines were gathered for each day of that week, chronicling both the events that were sparked by market uncertainty and market sentiment. The sentiment was then compared to the average loss or gain of the peso that day to determine if there was a positive correlation between media sentiment and the peso's value.

Monday, September 15, 2008

This day began with Lehman Brothers' bankruptcy filing, the effects of which were swiftly chronicled by Reuters headlines and tweets, a sample of which were provided below:

Table 1 Mainstream Media Headlines for Monday, September 15, 2008

Time (EDT)	Headlines on September 15, 2008	News Provider
4:46 AM	Lehman files for Bankruptcy	Reuters
7:32 AM	Lehman collapse hits global system	Reuters
8:24 AM	Fallout from financial crisis not over -IMF chief	Reuters
8:32 AM	Mexico peso falls over 1 pct on US financial woes	Reuters
8:51 AM	Mexico peso falls over 1 pct on US financial woes ⁴	Reuters
12:11 PM	Lehman sparks bank worries in Europe	Reuters
12:35 PM	Mexico's one-month Cetes yield dips to 8.16 pct	Reuters
1:15 PM	Wall Street crisis: Investors dump shares after Lehman collapse	The Guardian
1:21 PM	Banks lose after Lehman collapse	Reuters
1:30 PM	Shock waves hit Wall Street	Reuters
2:29 PM	Cascades proceeds with the sale of Scierie Lemay	Reuters
2:30 PM	Examine the 2008 Mexico Industry & Market Outlook Report: Providing Data on Over...	Reuters
2:48 PM	Emerging Markets-Assets smacked down by Wall Street ructions	Reuters
3:46 PM	Mexico peso, stocks hit hard by U.S. credit woes	Reuters
4:28 PM	Paulson says system is sound	Reuters
4:46 PM	U.S. credit woes slam Mexico stocks, peso	Reuters
5:48 PM	AutoNation: Access to credit an issue	Reuters

⁴ Note: The repetition of a headline indicates that an article was published again after it was updated with new or corrected information.

6:25 PM	Uncertainty Hits Wall Street After Lehman, Merrill Meltdown	PBS NEWSHOUR
6:46 PM	Panels on Emerging and Commodity Markets to be Broadcast Live From the CME	Reuters
6:47 PM	Financial crisis hits consumers	Reuters
7:10 PM	Markets plunge on financial fears	Reuters
7:29 PM	GM sees raising capital tough	Reuters
7:46 PM	Detroit reacts to Wall Street crisis	Reuters



Figure 6 Tweet from the @Reuters Twitter Account During the First Day of the Global Crisis

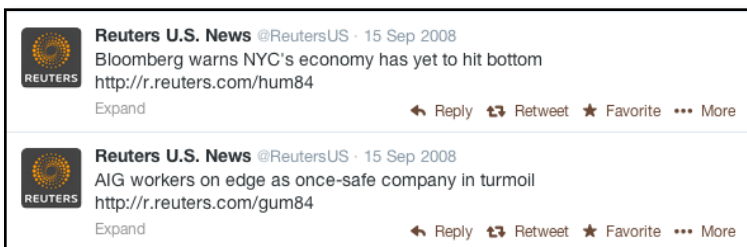


Figure 7 Similar Tweets Shared Though Reuters US Twitter Account

An analysis of the verbs and nouns used in *Reuters* headlines provides an interesting perspective of the main economic events and the sentiment in the market that day. Topics centered on the effect that the Lehman bankruptcy was having on the global economy, with the phrase “Lehman Brothers” mentioned in 240 *Reuters* headlines alone that Monday (*Reuters*, 2008b, “archives”). Though not the center of attention, Mexico received significant airtime with nine headline mentions. Even more telling were the verbs used to describe the actions of the markets in response to the uncertainty, including: “hit” (41 mentions), “falls” (22 mentions),

“plunge” (14 mentions), “collapse” (10 mentions) and “financial crisis” (6 mentions). “Fear” alone was mentioned 26 times that day, while “stress” received 28 mentions, indicating how rapidly market sentiment had deteriorated (Ibid).

Risk aversion led investors around the world to “dump emerging market assets” as one *Reuters* article put it (2008c), leading those asset prices to reflect the sentiment of the market overall instead of their individual values. In the case of the Mexican peso, a major devaluation occurred just a few hours after Lehman’s collapse, indicating the presence of an information cascade. According to the CME data, the Mexican peso lost a full two percent of its value (based on average closing floor prices) from Monday to Tuesday, and continued to fall well into Thursday (Table: Average Floor closing prices, September 2008).

The cascade was not lost on Mexican traders. According to Eduardo Saenger, head of equity trading at Bulltick Capital Markets in Mexico City, liquidity was going to be a big issue: “We are going [to] see that markets are going to sell off, until something very, very big happens to shows [sic] us a floor to stop the freefall [sic]” (as quoted in *Reuters*, 2008c). His comments indicated that until new, market-moving information was introduced to stop the “flight to quality” or herd away from “riskier” assets, then the peso and Mexican stock markets would continue to fall. This would likely make it difficult for the government, businesses and investors alike to acquire the cash or credit they needed for day-to-day business.

Tuesday, September 16, 2008

However, the events of Tuesday, September 16 served only to perpetuate the apparent cascade. Table 2 provides the narrative and sentiment of the day, demonstrating the growing sense of panic in the markets, particularly over the fate of the insurance giant AIG:

Table 2 Mainstream Media Headlines for Tuesday, September 16, 2008

Time (EDT)	Headlines on September 16, 2008	News Provider
1:02 AM	Lehman in talks to sell part of firm to Barclays-WSJ	Reuters
1:43 AM	Lehman bankruptcy rocks Asia	Reuters
2:58 AM	Blasts hit Mexico celebration, three dead	Reuters
7:56 AM	Automakers could use \$50 billion in loans: UAW	Reuters
8:30 AM	SNAPSHOT-Global financial market stress at a glance	Reuters
8:40 AM	Paulson, Bernanke talk AIG ideas with Senate leader	Reuters
8:49 AM	GLOBAL MARKETS-Global equity selloff wreaks havoc on money mkts	Reuters
2:41 PM	GLOBAL MARKETS-Stocks, oil drop as Wall St damage spreads	Reuters
3:42 PM	Grenade attacks kill 8 on Mexico's national day	Reuters
6:01 PM	AIG shares sink 21 pct as cash crisis mounts	Reuters
6:11 PM	Central banks strain to contain market crisis	Reuters
7:52 PM	Fed chairman, Paulson in AIG talks with Congress	Reuters
7:52 PM	AIG shrs plunge as crisis mounts, takeover mulled	Reuters
7:53 PM	AIG may get \$85-90 bln bridge loan in govt-brokered deal: CNBC	Reuters
7:54 PM	AIG shares pare losses in heavy after-hours trade	Reuters
7:55 PM	AIG rescue hopes, Morgan Stanley earnings, ease markets	Reuters
8:14 PM	Fed chairman, Paulson in AIG talks with Congress	Reuters
8:14 PM	U.S. weighs AIG conservatorship: Bloomberg	Reuters
8:14 PM	S&P likely to cut derivative deals on Lehman, AIG	Reuters
8:14 PM	No federal power for AIG conservatorship: source	Reuters
8:16 PM	INSTANT VIEW: Goldman Sachs earnings fall, stock lower	Reuters
8:16 PM	Bush sees efforts to stabilize markets: White House	Reuters
8:37 PM	Paulson, Bernanke talk AIG ideas with Senate leader	Reuters
9:32 PM	GM CEO says liquidity position is "solid"	Reuters
9:45 PM	Federal Reserve statement on AIG	Reuters

As before, a keyword analysis of the Reuters headlines archive provided a unique look at the sentiment in the market that day. AIG was the number one crisis-related topic with 154 mentions, followed by mentions of a crisis (24), losses (20), a rescue (18), worries (18), turmoil (12) and bankruptcy (12) (*Reuters*, 2008d, “archives”). The financial meltdown on Monday, September 15 had amplified the financial struggles of insurance giant AIG, causing it to seek the help of the US Federal Reserve. Realizing the failure of AIG would cause more systemic risk within global markets, the US government set aside its “moral hazard” platform and began to look for a solution to the “too big to fail” problem. With talks of rescues, the use of the word

“fear” was significantly reduced to only ten mentions on Tuesday, September 16, compared to the 26 mentions the previous day. The most popular verbs used on Tuesday were “fall” (64 mentions) and “cuts” (30 mentions), indicating the movement of the stock markets and the withdrawal of credit from the market (Ibid).

There were only three major mentions of Mexico Tuesday, September 16 focusing on the country’s first ever grenade attack by the drug cartels during the drug war. Correlating with the lack of media mentions, the depreciation of the peso slowed from a two percent loss on Monday to an average of 0.09 percent loss on Tuesday. It is possible that the peso would have suffered more, but, as indicated by the headlines, talks of an AIG rescue were receiving most of the media attention that day. Overall, media coverage on Tuesday, September 16 was calmer than the previous day as people waited to see what would happen to AIG.

Wednesday, September 17, 2008

For reasons unknown, by Wednesday the markets were in a full-blown panic, with predictions of an all-out financial meltdown, even if the US government chose to bail out AIG. The sheer volume of headlines devoted to the crisis that day indicated the growing panic, as headlines read like play-by-plays of a basketball game. At this point, any asset that might have had the slightest connection to the crisis unfolding in the United States was affected by the negative market sentiment. By all appearances, an information cascade was in full swing, with severe market movements fueling provocative headlines, and volumes of headlines fueling the panic:

Table 3 Mainstream Media Headlines for Wednesday, September 17, 2008

Time (EDT)	Headlines on September 17, 2008	News Provider
12:08 AM	After AIG rescue, Fed may find more at its door	Reuters
1:01 AM	FDIC insurance fund can cover high losses -- Bair	Reuters
2:00 AM	REG-American Intl Group AIG Statement on Announcement by Federal Reserve Board of \$85 Billion Secured Revolving Credit Facility	Reuters
2:42 AM	GLOBAL MARKETS-Stocks gain, oil rallies on AIG rescue	Reuters
3:34 AM	AIG share crash means more pain for top U.S. firms	Reuters
4:46 AM	IMF head: worst of financial crisis may lie ahead	Reuters
5:48 AM	Financial crisis will hit European growth-Austria	Reuters
6:05 AM	U.S. futures fall as AIG rescue fails to quell fears	Reuters
8:15 AM	AIG shares fall before market open	Reuters
9:03 AM	US STOCKS-Futures sink on bank credit strains, AIG	Reuters
9:29 AM	Mexico peso weakens on credit market jitters	Reuters
9:33 AM	AIG's credit protection costs plunge after rescue	Reuters
9:36 AM	RPT-Mexico peso weakens on credit market jitters	Reuters
9:39 AM	US STOCKS-Wall St starts lower on credit strains, AIG	Reuters
9:41 AM	AIG shares drop at the market open	Reuters
9:41 AM	Fed refrains from open market operations so far	Reuters
9:48 AM	FOREX-Dollar, yen stumble as AIG rescue revives risky trades	Reuters
10:03 AM	US STOCKS-Wall St slides on credit woe, AIG fallout	Reuters
10:09 AM	INSTANT VIEW: U.S. bails out insurer AIG with \$85 bln loan	Reuters
10:34 AM	Mexico peso extends losses on credit worries	Reuters
10:57 AM	S STOCKS-Market off 2 pct on bank fears, AIG fallout	Reuters
11:09 AM	Mexico peso sinks to 6-month low; stocks fall 1 pct	Reuters
12:14 PM	Mexico weekly gasoline hikes to begin on Friday	Reuters
1:02 PM	WRAPUP 1-Commodity markets grapple with AIG's woes	Reuters
1:25 PM	Mexico: One of the Safest Places to Invest Right Now	Seeking Alpha
2:44 PM	Mexico peso sinks to 6-month low on credit worries	Reuters
3:22 PM	Mexico markets slammed by global credit fears	Reuters
3:24 PM	AIG orderly exit from U.S. grains heartens traders	Reuters
3:44 PM	UPDATE 1-Mexico same-store sales up 0.8 pct in August	Reuters
4:10 PM	Mexico stocks shed 4.72 pct amid global credit fears	Reuters
4:47 PM	Mexico says talks advance between Cemex and Caracas	Reuters
4:47 PM	Dollar falls vs. euro, yen despite AIG bailout	Reuters
5:10 PM	Mexico markets slide as credit fears spur sell-off	Reuters
5:27 PM	Emerging Markets-Financial, recession fears cause more losses	Reuters
5:29 PM	White House says concerned about more companies	Reuters

6:01 PM	Wall St. woes force US to seek cash for Fed	Reuters
6:01 PM	GE shares down, CEO sees no need to panic	Reuters
6:21 PM	Mexico's Calderon: End tolerance of crime	Reuters
6:46 PM	Bank fears, AIG fallout drive Wall St sell-off	Reuters
7:30 PM	UPDATE 1-Mexico finmin says inflation has peaked	Reuters
9:22 PM	Fed takes heat on AIG from both sides of Congress	Reuters
10:07 PM	Auto uncertainty puts brakes on deals	Reuters
10:53 PM	AIG rescue signals to Wall St that crisis not over	Reuters
11:57 PM	For AIG, \$85 billion might not be enough	Reuters



Figure 8 Tweets from Reuters US Account Conveying the Fear in Financial Markets

Keywords used on this day were significantly more pessimistic. The fact that the government was willing to bailout AIG despite its former stance against “moral hazard” signaled to the markets that the risk might be more systematic than previously thought. The rescue temporarily rallied the markets shortly after it was approved, but the sentiment quickly turned sour again. Popular keywords included “down” (49 mentions), “sell” (38 mentions), and “loses” (22 mentions) (*Reuters*, 2008e, “archives”).

Perceived risk in the market abounded because no one knew to what extent investments were exposed. The most-frequently mentioned nouns included “gold” in the context of buying it instead of stocks (67 mentions); continued discussions about an AIG “rescue” (35 mentions); talks of a “crisis” (34 mentions) and “exposure” to Lehman Brothers investments (28 mentions). The mentions of the word “fear” tripled compared to Tuesday (31 mentions versus 10), indicating that risk aversion was once again growing among investors. Even Mexico was

mentioned 22 times, primarily within the context of the financial crisis, and with occasional updates on the war against the drug cartels (ibid). The “flight to quality,” or in this case the flight to gold, meant that both the Mexican peso and stock market were negatively perceived and affected. The peso fell another 0.08 percent by the end of Wednesday, bringing the total loss to 2.17 percent over the first three days of the meltdown (September 15-17).

Thursday, September 18, 2008

After the panic and AIG rescue on Wednesday, the markets seemed more relaxed on Thursday. Mainstream media reports started off negatively, reporting on the fear that the worst of the crisis was still to come. In response, during the early morning hours, central banks (20 mentions) around the world worked to inject liquidity (17 mentions) into their markets to ease the problems that tight credit was creating in financial markets. As a result, markets rallied later Thursday morning, allowing mainstream media to focus on other events in the world such as the Olympics and third quarter dividends (a popular topic at 73 mentions) (*Reuters*, 2008f, “archives”).

Time (EDT)	Headlines on September 18, 2008	News Provider
12:01 AM	Worst Crisis Since '30s, With No End Yet in Sight	Wall Street Journal
12:12 AM	GLOBAL MARKETS-Raw fear pummels stocks, helps bonds	Reuters
12:27 AM	RPT-WRAPUP 1-Wall St dealmaking intensifies, markets tumble	Reuters
3:02 AM	Wall Street woes force US to seek cash for Fed	Reuters
3:24 AM	US Fed details FX swaps agreements with cenbanks	Reuters
4:46 AM	Prison riot in Mexico border city kills 19	Reuters
6:00 AM	U.S. stocks futures up on coordinated cbank action	Reuters
10:28 AM	Mexico peso, stocks gain on global liquidity boost	Reuters
11:32 AM	Morgan Stanley, Goldman shares tumble further	Reuters
12:05 PM	US STOCKS-Market slips amid financial sector fears	Reuters
12:56 PM	Mexico peso weakens sharply on credit fears	Reuters

Table 4 Mainstream Media Headlines for Thursday, September 18, 2008

1:02 PM	Europe stocks fall despite liquidity boost	Reuters
1:14 PM	US STOCKS-Market drops as financial-sector worries persist	Reuters
1:36 PM	Mexican peso, stocks slip on credit worries	Reuters
1:55 PM	Credit market meltdown	Reuters
2:00 PM	Household wealth falls for third straight quarter	Reuters
2:30 PM	Economy seen sluggish through mid-09	Reuters
3:06 PM	ANALYSIS-Grenade attacks raise stakes in Mexico drug war	Reuters
3:16 PM	US STOCKS-Market jumps on Paulson plan report	Reuters
4:03 PM	UPDATE 1-Mexico July industrial output falls 0.2 pct	Reuters
4:05 PM	Mexico stocks surge on US rescue plan optimism	Reuters
4:11 PM	Mexico detains two suspects over grenade attack	Reuters
4:36 PM	US STOCKS-Wall St rallies on crisis solution hopes	Reuters
4:37 PM	Bush meets economic advisers on financial crisis	Reuters
5:00 PM	Emerging Markets-Bond spreads narrow on hopes for mkt solution	Reuters

However, by noon on Thursday it was evident that US investment banks were still struggling with risk and liquidity, causing the markets and the media to reflect investor pessimism. While the crisis was not the major focus of mainstream media that day, there were still significant mentions of the word crisis (46 mentions), fear (16 mentions) and exposure (13 mentions). By 4 p.m. EDT, the conversation took a more positive turn again with talks of a “solution” (58 mentions). US Secretary of the Treasury Hank Paulson had announced a plan for one big bailout to end the uncertainty in the markets. Mentions of “hope” were the highest they had been since Monday, September 15 at 22 mentions (Ibid).

During this time, the Mexican peso also fluctuated with the market, as chronicled by the Reuters headlines. After having depreciated most of Thursday afternoon, the peso gained a little traction with talks of Paulson’s Toxic Asset Relief Program (TARP). In the end, the peso appreciated a sizable one percent by the end of Thursday.

Friday, September 19, 2008

Talks of a rescue plan carried into Friday, significantly lifting the mood in the markets, helping to eliminate some of the uncertainty. The goal of TARP was to remove the toxic assets

from the market that were causing so much uncertainty. A keyword analysis showed that popular mentions during this time included talk of the “plan” at 134 mentions, acknowledgment of the “crisis” at 42 mentions, a market “rally” at 23 mentions, and “rescue” and “bailout” used interchangeably at 22 and 20 mentions respectively (*Reuters*, 2008g, “archives”). The word “fear” was only mentioned in one headline the entire day, and was in reference to the hedge funds’ fear of the discussions about new market regulations. Mexico was mentioned 12 times, and, with the exception of the mentions of the grenade attack from the previous day, all of the mentions were positively related to the “plan” talks (*ibid*). Therefore, the Mexican peso rallied into the weekend, appreciating another 1.6 percent between Friday morning and the opening of the markets on Monday, September 22.

Table 5 Mainstream Media Headlines for Friday, September 19, 2008

Time (EDT)	Headlines on September 19, 2008	News Provider
12:17 AM	Mexico questions men over grenade attack	Reuters
12:08 PM	Mexico's Calderon: End tolerance of crime	Reuters
12:08 PM	Grenade attacks raise stakes in Mexico drug war	Reuters
12:51 PM	Mexico markets soar on U.S. government crisis plan	Reuters
3:08 PM	Mexico peso surges on U.S. crisis plan	Reuters
3:47 PM	NYMEX-Crude ends up over 6 pct on stability plan	Reuters
3:50 PM	U.S. moves take heat off banks for shotgun mergers	Reuters
4:09 PM	US STOCKS-Wall St rallies on U.S. rescue plan	Reuters
4:10 PM	Mexico stocks surge on hopes of U.S. credit plan	Reuters
4:10 PM	Oil posts biggest 3-day gain since 1998	Reuters
4:56 PM	UPDATE 1-Treasury plan seen in Congress within 24 hrs-aides	Reuters
5:01 PM	Mexico peso, stocks climb on U.S. crisis plan	Reuters
6:00 PM	TOPWRAP 6-U.S. toxic-debt plan, short-selling curbs lift markets	Reuters
6:22 PM	Treasury could buy debt for 2 years under plan: report	Reuters
7:26 PM	CORRECTED - Emerging Markets-Stocks and bonds soar after U.S. bailout plan	Reuters
7:26 PM	U.S. launches all-out attack on credit crisis	Reuters
11:45 PM	U.S. to propose \$500-\$800 billion asset-buy plan: sources	Reuters

There was a very strong, positive correlation between the sentiment of *Reuters* headlines and the volatility of the Mexican peso during the first week after the failure of the Lehman Brothers investment bank. The week in question represented a period of significant uncertainty in financial markets, prompting investors to become more risk adverse. In addition, this week represented a period of time when Mexico was relatively calm, experiencing no major political upsets, elections or natural disasters. Even when Mexico experienced its first grenade attack of the drug war signally possible instability within the country, the peso appreciated because the stock markets in the US were rallying. Thus, the volatility of the peso during this time period could possibly be attributed to investors trading on sentiment conveyed through media, rather than on new information about changes in the stability of Mexico or its macroeconomic fundamentals.

Overall, the relationship between media sentiment and volatility in the peso was found to be positive. As articles became more pessimistic, there was stronger downward pressure on the average closing price of the peso. Sentiment-based information cascades were also found to be short-term when the macroeconomic fundamentals of Mexico did not change during the period of observation. As uncertainty was removed from the market with definitive talks of the US governments' TARP plan, the media became less pessimistic, and the peso regained nearly all the value it had lost during the previous week within seven days of the initial drop in price.

In the event that the peso had not regained its original value when the US market conditions improved, that would have indicated a fundamental change had occurred within Mexico's economy, causing the value of the peso to remain at a depressed price as other assets recovered. This situation occurred on September 29, 2008, when the US Congress failed to pass the TARP plan the first time it was proposed. The two weeks prior to this rejection had been full

of discussions about how important it was for the toxic assets to be removed from the markets in order to prevent a global credit crisis. When the first draft of the TARP bill failed to gain the votes it needed, “certainty” entered the markets – specifically, the certainty that global credit markets were in trouble. Thus, the severe downward pressure applied to financial markets globally and the price of the Mexican peso was a reaction to a fundamental change in the markets. In this situation, the price of the peso fell because demand for the peso fell; investors wanted US dollars, bonds or gold more than they wanted pesos. The “flight to quality” explains why the value of the peso continued to fall, even once the second draft of TARP was passed. This prolonged devaluation adversely impacted Mexico’s domestic economy, as terms of trade deteriorated and access to credit was limited.

By December 2008, Mexico was deep in a recession, struggling with high unemployment and increasing levels of poverty and violence. In the two months that followed the approval of the second draft of TARP and the use of those funds to rescue of the US auto manufacturers, the Mexican peso had lost nearly a quarter of its value. The fact that the rescue of US auto companies with their significant ties to Mexico’s domestic economy still did not result in the recovery of the peso confirmed that the fundamental state of the Mexican economy had changed. This instability in Mexico’s economy was reflected in the value of the peso, explaining why the currency continued to devalue even as the recession in the United States was starting to ease.

Chapter 7: Discussion and Concluding Thoughts

Ultimately, this analysis illustrated scenarios in which Mexico could be vulnerable to herd behavior and media sentiment from outside of its borders. Mexico's history of financial crises and its close connection to the United States through trade means that the country may already face more investor scrutiny than other Latin American countries. It also means that investors' decisions to withdraw from Mexican assets during times of financial distress in the United States are rational, already creating prime conditions for spurious (non-intentional) herding away from the peso during periods of uncertainty.

However, with the evolution of information technology, Mexico also faces the possibility that a flight away from the peso could be augmented through faster information sharing and the instantaneous, large-volume trades initiated by HFT algorithms reacting to negative news. The highly visible HFT algorithm trades can over-exaggerate the fall in the price of the peso already initiated by naturally-occurring spurious herding among investors. The rapidity of the fall in the price of the peso can then create uncertainty around the peso's true value, causing investors to doubt their own information even as the price falls well below the point of what the currency is actually worth. If the cascade is not "broken" quickly enough with the introduction of solid facts about the state of macroeconomic fundamentals within Mexico, the cascade has the potential to snowball into an inefficient, large-scale flight of capital that may have a more profound adverse effect on the Mexican economy as a whole.

The presence of high-speed trading and information-sharing tools has major implications for Mexico. First, having strong macroeconomic fundamentals is no longer a sufficient safeguard against external crises. Research by Cutler et al. (1989) demonstrated how those actions might affect only a third of market price volatility, a conclusion that is consistent with the findings of

this research. As Tetlock concluded, and this analysis concurs, media sentiment plays a significant role in the volatility of asset prices in the markets. And while Calvo and Mendoza demonstrated how globalization has made it easy for investors to herd by overloading them with choices, this research has described how the evolution in information technology has made opportunities for herding in Mexican currency markets faster and more systematic through new research behaviors and the use of HFT algorithms.

Second, the use of social media as a tool to gather news and the sentiment of the market is also becoming systemized. According to Journalist Matt Honan, Twitter is now being used as the “labor and delivery room of information [...] help[ing] journalists find emerging information and sources” (2014). The same breaking news that is being fed into digital newswires and used by automatic trading algorithms is, in part, being sourced from social media from firsthand witnesses rather than trained journalists.

In addition, as explained by the MarketWired research (2013) and Lovas of OneMarketData (Szalay, 2014), more investors and algorithms are starting to rely on social media platforms like Twitter to keep a finger on the pulse of the market. This means that when negative information about a company – or even a country – comes to light, that information can be shared and used instantaneously by investors and their algorithms to make trading decisions before there is time to verify its accuracy. This information can come from anywhere in the world and is very difficult to censor, meaning that the only way to counteract the effects of misinformation is to immediately publish accurate facts about the peso through sources considered “authoritative” by the investment community.

While the presence of digital information technologies may present several challenges to the Mexican economy during periods of uncertainty, this same technology may provide the

Mexican government a unique opportunity to address pending economic crises. For the first time, social media provides emerging economies like Mexico the ability to monitor sentiment about their country in real time. Whole software systems have been developed specifically for governments to track these kinds of data, allowing governments to take a proactive approach to policy making and reputation management. By using social media, rather than fearing it, governments can contribute to the articles being written about their countries and economies; they can become an authoritative source of news for journalists, investors and business partners.

In addition, social media channels can give governments a platform where they can lend clarity to the market in times of crisis, helping remove the uncertainty around their currency values that causes foreign investors to become so risk adverse. By actively monitoring sentiment on multiple channels, governments will have a better understanding of what investors perceive to be the economy's weaknesses. They will then be able to address that uncertainty with more appropriate policy measures. In the end, it is imperative for governments in emerging economies to track the new ways markets function. Doing so may help reduce the financial resources needed to counteract economic crises, ultimately freeing up those funds for domestic development.

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Appendix A

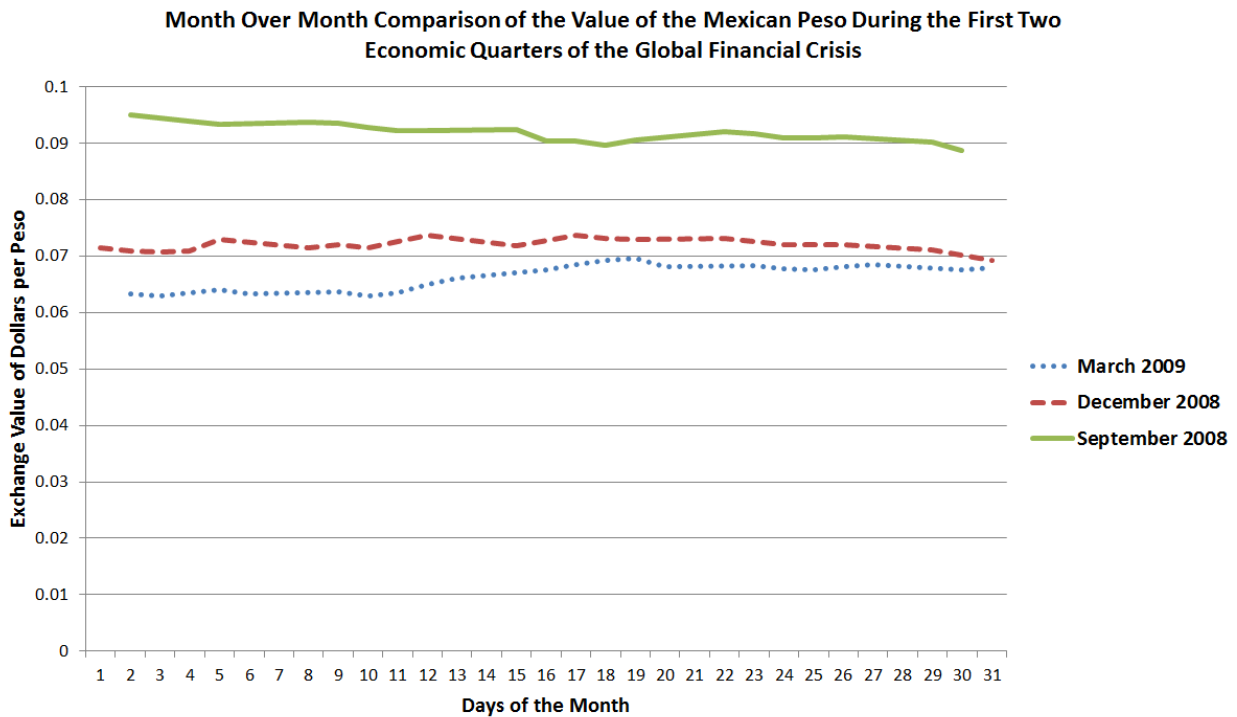
Summary of the CME Group Data utilized in the form of average floor closing prices.

Average Floor Closing Prices			
Date	September	December	March
1		0.07148125	
2	0.09506875	0.07085625	0.0633625
3	0.09445	0.0707875	0.06295
4	0.093975	0.070875	0.06349
5	0.0933	0.072875	0.06399
6			0.06333
7			
8	0.09364375	0.07144375	
9	0.09343125	0.0719625	0.06365
10	0.0928	0.0714625	0.0629625
11	0.092225	0.07265	0.0634
12	0.09224375	0.07367	0.064879167
13			0.066066667
14			
15	0.09245	0.071825	
16	0.09045	0.0727125	0.067508333
17	0.0903625	0.07361	0.06857
18	0.0896	0.073035	0.06915
19	0.090566667	0.072875	0.06965
20			0.06812
21			
22	0.092075	0.073175	
23	0.091675	0.072615	0.06835
24	0.090866667	0.071955	0.0678
25	0.090933333		0.067625
26	0.091075	0.07198	0.068045
27			0.0685
28			
29	0.090175	0.071105	
30	0.088733333	0.070175	0.06758
31		0.069205	0.06785
	Represents Weekends and Holidays. The CME Exchange was closed.		

Appendix B

Baseline comparison of the daily average floor closing price for the peso in September 2008,

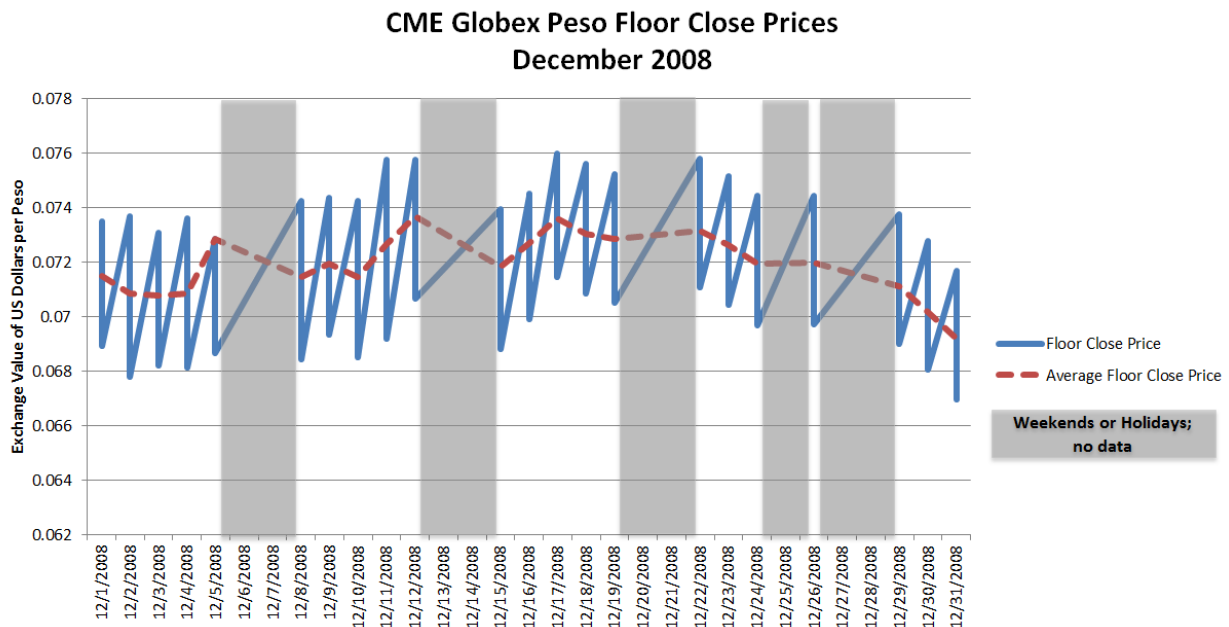
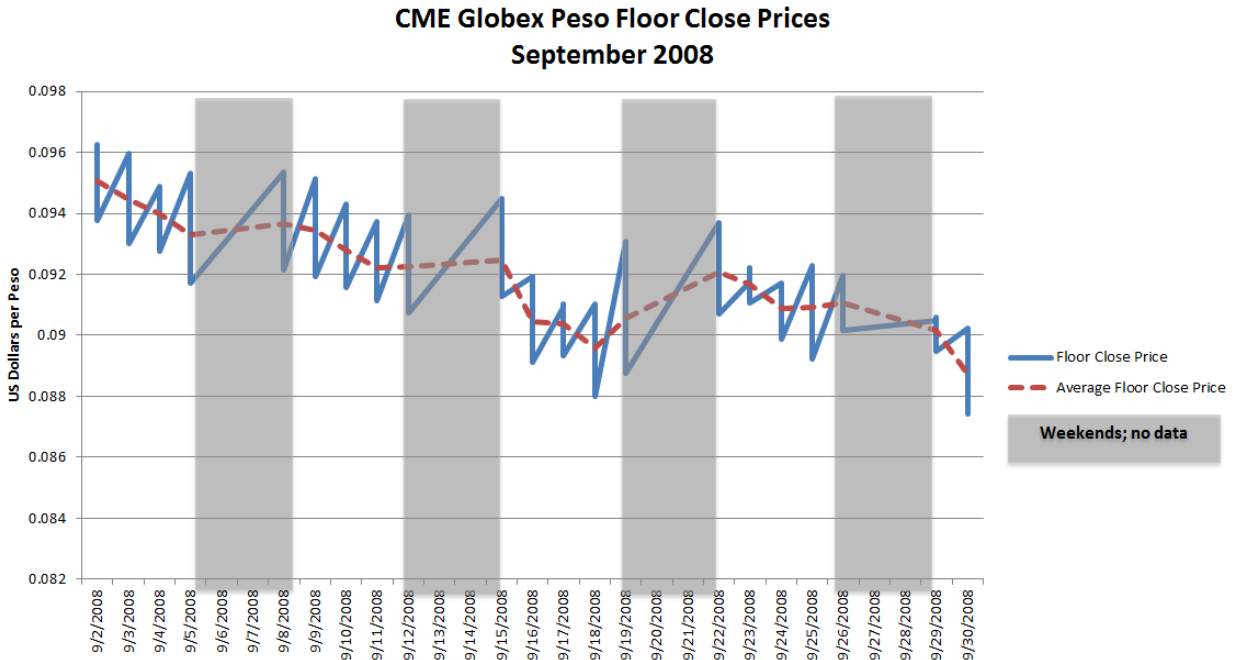
December 2008 and March 2009.



Appendix C

Daily averages and actual prices of the Mexican peso according to CME data for September

2008, December 2008 and March 2009.



Appendix C (cont.)

